

CE / ACMA SAR Test Report

APPLICANT : Quanta Computer Inc.
EQUIPMENT : Laptop Computer
BRAND NAME : OLPC
MODEL NAME : XO-4 Touch, XO-4 HS Touch, XO-4, XO-4 HS
STANDARD : ARPANSA Radiation Protection Standard
(Maximum Exposure Levels to
Radiofrequency Fields – 3 kHz to 300 GHz)
ACA Radiocommunications (Electromagnetic
Radiation - Human Exposure) Standard 2003
EN 62311:2008
EN 62209-2:2010
EN 62479:2010
TEST DATE(S) : Feb. 12, 2013 ~ Feb. 14, 2013

The measurements shown in this test report were found to be in accordance with the requirements given in EUROPEAN COUNCIL DIRECTIVE 1999/519/EC, EN 62311:2008 and EN62479:2010, and in accordance with the procedure given in standard EN 62209-2:2010

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.

Reviewed by:



Jones Tsai / Manager



SPORTON INTERNATIONAL (KUNSHAN) INC.
No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C.



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Appendix A. Plots of System Performance Check

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
EA2D1707	Rev. 01	Initial issue of report	Feb. 25, 2013

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Quanta Computer Inc.**
DUT: Laptop Computer, Brand Name: OLPC, Model Name: XO-4 Touch, XO-4 HS Touch, XO-4, XO-4 HS are as follows.

<Standalone SAR>

Band	Position	SAR _{10g} (W/kg)
WLAN 2.4GHz	Body (0 cm Gap)	0.302
WLAN 5GHz	Body (0 cm Gap)	0.073

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (2.0 W/kg) specified in Council Recommendation 1999/519/EC, ICNIRP, and R&TTE Directive - 1999/5/EC: EN 62311:2008, and EN62479:2010, and had been tested in accordance with the measurement methods and procedures specified in EN 62209-2:2010.

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C. TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958

2.2 Applicant

Company Name	Quanta Computer Inc.
Address	No.188, Wen Hwa 2nd Rd., Kuei Shan Hsiang, Tao Yuan Shien, TaiWan

2.3 Manufacturer

Company Name	Quanta Computer Inc.
Address	No.188, Wen Hwa 2nd Rd., Kuei Shan Hsiang, Tao Yuan Shien, TaiWan

2.4 Application Details

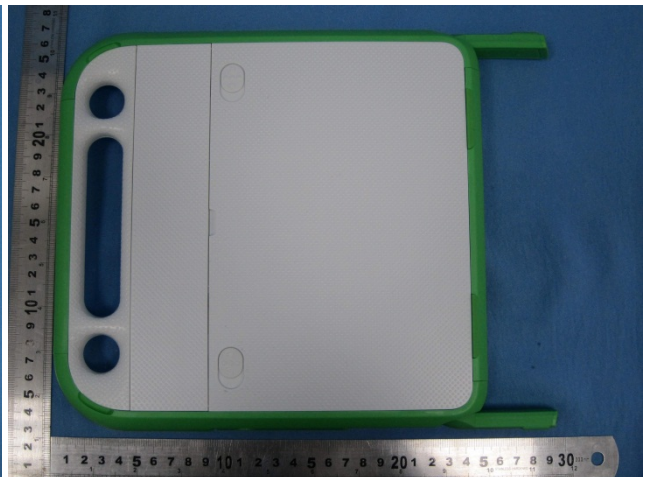
Date of Start during the Test	Feb. 12, 2013
Date of End during the Test	Feb. 14, 2013

3. General Information

3.1 Description of Device Under Test (DUT)

Product Feature & Specification																
Equipment	Laptop Computer															
Brand Name	OLPC															
Model Name	XO-4 Touch, XO-4 HS Touch, XO-4, XO-4 HS															
WLAN Module	Trade Name: Liteon Model Name: WCBN603MH															
Tx Frequency	WLAN 2.4GHz: 2412 MHz ~ 2472 MHz WLAN 5GHz: 5150 MHz ~ 5250 MHz Bluetooth: 2402 MHz ~ 2480 MHz															
Antenna Type	WLAN: Monopole Antenna Bluetooth: Monopole Antenna															
Type of Modulation	802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) Bluetooth BDR (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK															
DUT Stage	Identical Prototype															
Remark:																
1. There are four models of this project. The differences between them are summary below:																
<table border="1"> <thead> <tr> <th>Sample List</th> <th>Model Name</th> <th>Configuration</th> </tr> </thead> <tbody> <tr> <td>Sample 1</td> <td>XO-4 Touch</td> <td>Child Product with touch screen</td> </tr> <tr> <td>Sample 2</td> <td>XO-4 HS Touch</td> <td>ITE Product with touch screen</td> </tr> <tr> <td>Sample 3</td> <td>XO-4</td> <td>Child Product without touch screen</td> </tr> <tr> <td>Sample 4</td> <td>XO-4 HS</td> <td>ITE Product without touch screen</td> </tr> </tbody> </table>		Sample List	Model Name	Configuration	Sample 1	XO-4 Touch	Child Product with touch screen	Sample 2	XO-4 HS Touch	ITE Product with touch screen	Sample 3	XO-4	Child Product without touch screen	Sample 4	XO-4 HS	ITE Product without touch screen
Sample List	Model Name	Configuration														
Sample 1	XO-4 Touch	Child Product with touch screen														
Sample 2	XO-4 HS Touch	ITE Product with touch screen														
Sample 3	XO-4	Child Product without touch screen														
Sample 4	XO-4 HS	ITE Product without touch screen														
The four types of EUT is not affect SAR test, we only choose sample 1 to perform all test.																
2. The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.																
3. Voice call is not supported.																

3.2 Product Photos



3.3 Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

- Council Recommendation 1999/519/EC
- ARPANSA Radiation Protection Standard (Maximum Exposure Levels to Radiofrequency Fields – 3 kHz to 300 GHz)
- ACA Radio communications (Electromagnetic Radiation - Human Exposure) Standard 2003
- EN 62311:2008
- EN 62209-2:2010
- EN 62479:2010

3.4 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 2.0 W/kg as averaged over any 10 gram of tissue.

3.5 Test Conditions

3.5.1 Ambient Condition

Ambient Temperature	20 to 24 °C
Humidity	< 60 %

3.5.2 Test Configuration

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal.

4. Specific Absorption Rate (SAR)

4.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt} \left(\frac{dW}{dm} \right) = \frac{d}{dt} \left(\frac{dW}{\rho dv} \right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c \left(\frac{\delta T}{\delta t} \right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

5. SAR Measurement System

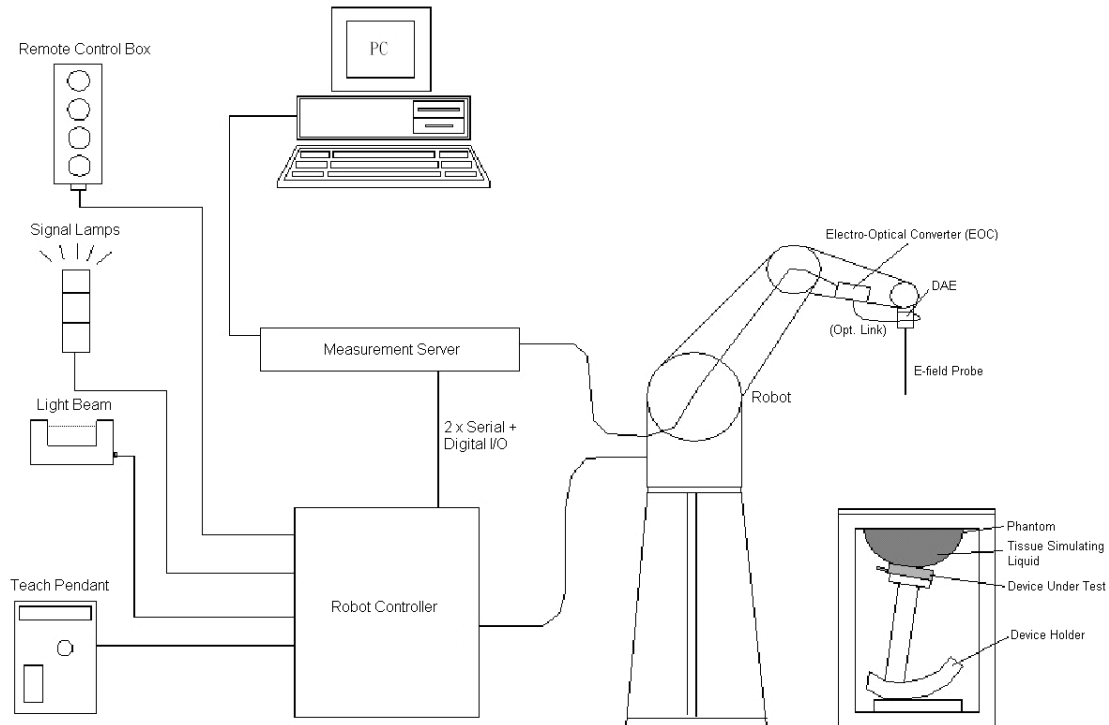


Fig 5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY software
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

5.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG). The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

5.1.1 E-Field Probe Specification

<EX3DV4 Probe>


Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 μ W/g)	
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

Fig 5.2 Photo of EX3DV4

5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than $\pm 10\%$. The spherical isotropy shall be evaluated and within ± 0.25 dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

5.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig 5.3 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ± 0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)



Fig 5.4 Photo of DASY5

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.



Fig 5.5 Photo of Server for DASY5

5.5 Phantom

<ELI4 Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm



Fig 5.6 Photo of ELI4 Phantom

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

5.6 Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

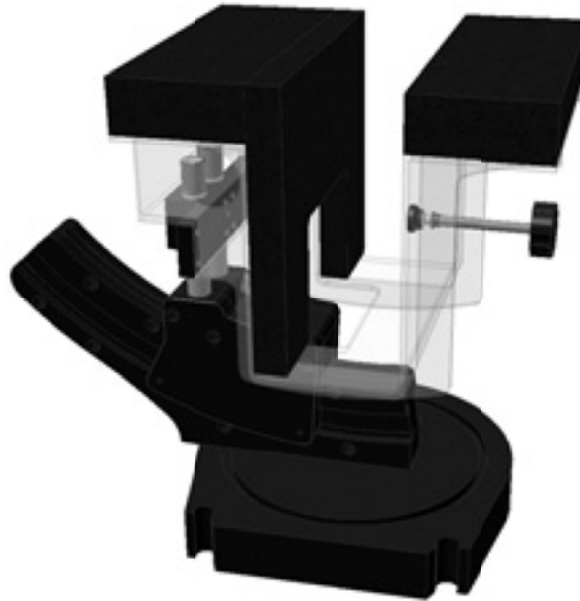


Fig 5.7 Laptop Extension Kit

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i, a_{i0}, a_{i1}, a_{i2}$
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power.

The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i, (i = x, y, z)
 U_i = input signal of channel i, (i = x, y, z)
 cf = crest factor of exciting field (DASY parameter)
 dcp_i = diode compression point (DASY parameter)

From the compensated input signals, the primary field data for each channel can be evaluated:

$$\text{E-field Probes: } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-field Probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

with V_i = compensated signal of channel i, (i = x, y, z)
 Norm_i = sensor sensitivity of channel i, (i = x, y, z), $\mu\text{V}/(\text{V/m})^2$ for E-field Probes
 ConvF = sensitivity enhancement in solution
 a_{ij} = sensor sensitivity factors for H-field probes
 f = carrier frequency [GHz]
 E_i = electric field strength of channel i in V/m
 H_i = magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{\text{tot}} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$\text{SAR} = E_{\text{tot}}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in mW/g
 E_{tot} = total field strength in V/m
 σ = conductivity in [mho/m] or [Siemens/m]
 ρ = equivalent tissue density in g/cm³

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	736	Jul. 25, 2011	Jul. 24, 2013
SPEAG	5000MHz System Validation Kit	D5GHzV2	1006	Dec. 11, 2012	Dec. 10, 2013
SPEAG	Data Acquisition Electronics	DAE4	1210	Dec. 05, 2012	Dec. 04, 2013
SPEAG	Dosimetric E-Field Probe	EX3DV4	3857	Jun. 20, 2012	Jun. 19, 2013
SPEAG	ELI4 Phantom	QD OVA 001 BB	1079	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	Wireless Communication Test Set	E5515C	MY48367160	Oct. 25, 2012	Oct. 24, 2013
R&S	Universal Radio Communication Tester	CMU200	116456	Sep. 19, 2012	Sep. 18, 2013
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	Apr. 13, 2012	Apr. 12, 2013
Agilent	Dielectric Probe Kit	85070E	MY44300475	NCR	NCR
AR	Amplifier	551G4	333096	NCR	NCR
Agilent	Power Meter	E4416A	MY45101555	Aug. 22, 2012	Aug. 21, 2013
Agilent	Power Sensor	E9327A	MY44421198	Aug. 22, 2012	Aug. 21, 2013
ARRA	Power Divider	A3200-2	N/A	NA	NA
MCL	Attenuation	BW-S10W5	N/A	NA	NA

Table 5.1 Test Equipment List

Note:

1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The justification data of dipole D2450V2: SN 736 can be found in appendix C. The dipole is not physically damaged, and the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration.

6. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.



Fig 6.1 Photo of Liquid Height for Head SAR



Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ϵ_r)
2450	55.0	0	0	0	0	45.0	1.80	39.2

Table 6.1 Recipes of Tissue Simulating Liquid

Simulating Liquid for 5G, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%



The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Freq. (MHz)	Temp. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
2450	21.2	1.809	37.604	1.80	39.2	0.50	-4.07	±5	Feb. 12, 2013
5200	21.3	4.814	35.458	4.66	36.0	3.30	-1.51	±5	Feb. 14, 2013

Table 6.2 Measuring Results for Simulating Liquid

7. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture’s specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/k ^(b)	1/√3	1/√6	1/√2

- (a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
- (b) κ is the coverage factor

Table 7.1 Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 7.2 and Table 7.3.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (10g)	Standard Uncertainty (10g)
Measurement System					
Probe Calibration	6.0	Normal	1	1	± 6.0 %
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %
Linearity	4.7	Rectangular	√3	1	± 2.7 %
Modulation Response	2.4	Rectangular	√3	1	± 1.4 %
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %
Readout Electronics	2.0	Normal	1	1	± 2.0 %
Response Time	0.8	Rectangular	√3	1	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %
Probe Positioner	0.8	Rectangular	√3	1	± 0.5 %
Probe Positioning	6.7	Rectangular	√3	1	± 3.9 %
Post-processing	4.0	Rectangular	√3	1	± 2.3 %
Test Sample Related					
Device Positioning	3.6	Normal	1	1	± 3.6 %
Device Holder	2.9	Normal	1	1	± 2.9 %
Power Drift	0.0	Rectangular	√3	1	± 0.0 %
Power Scaling	5.0	Rectangular	√3	1	± 2.9 %
Phantom and Setup					
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %
SAR correction	1.9	Rectangular	√3	0.84	± 0.9 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.71	± 1.8 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.26	± 0.7 %
Temp. unc. - Conductivity	1.7	Rectangular	√3	0.71	± 0.7 %
Temp. unc. - Permittivity	0.3	Rectangular	√3	0.26	± 0.0 %
Combined Standard Uncertainty					± 11.7 %
Coverage Factor for 95 %					K=2
Expanded Uncertainty					± 23.4 %

Table 7.2. Uncertainty Budget of DASY for frequency range 30 MHz to 3 GHz
According to EN 62209-2/2010

Error Description	Uncertainty	Probability Distribution	Divisor	C _i (10g)	Standard
	Value (±%)				Uncertainty (10g)
Measurement System					
Probe Calibration	6.55	Normal	1	1	± 6.55 %
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %
Linearity	4.7	Rectangular	√3	1	± 2.7 %
Modulation Response	2.4	Rectangular	√3	1	± 1.4 %
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %
Readout Electronics	2.0	Normal	1	1	± 2.0 %
Response Time	0.8	Rectangular	√3	1	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %
Probe Positioner	0.8	Rectangular	√3	1	± 0.5 %
Probe Positioning	6.7	Rectangular	√3	1	± 3.9 %
Post-processing	4.0	Rectangular	√3	1	± 2.3 %
Test Sample Related					
Device Positioning	3.6	Normal	1	1	± 3.6 %
Device Holder	2.9	Normal	1	1	± 2.9 %
Power Drift	0.0	Rectangular	√3	1	± 0.0 %
Power Scaling	5.0	Rectangular	√3	1	± 2.9 %
Phantom and Setup					
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %
SAR correction	1.9	Rectangular	√3	0.84	± 0.9 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.71	± 1.8 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.26	± 0.7 %
Temp. unc. - Conductivity	1.7	Rectangular	√3	0.71	± 0.7 %
Temp. unc. - Permittivity	0.3	Rectangular	√3	0.26	± 0.0 %
Combined Standard Uncertainty					± 12.0 %
Coverage Factor for 95 %					K=2
Expanded Uncertainty					± 24.0 %

Table 7.3. Uncertainty Budget of DASY for frequency range 3 GHz to 6 GHz According to EN 62209-2/2010

8. SAR Measurement Evaluation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

8.1 Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

8.2 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

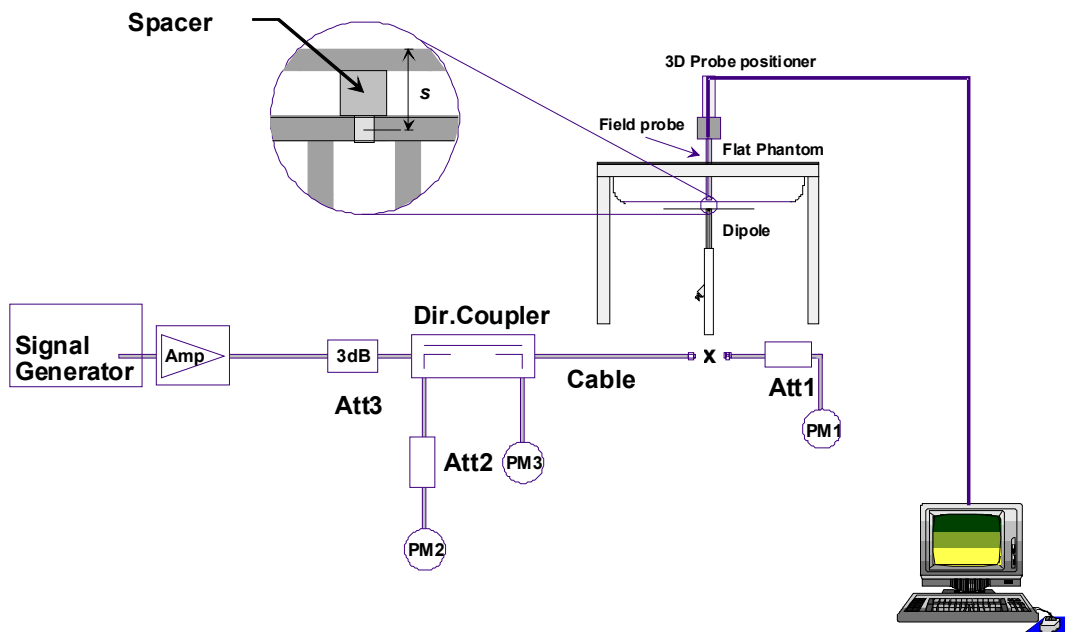


Fig 8.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.



Fig 8.2 Photo of Dipole Setup

8.3 Validation Results

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Measurement Date	Frequency (MHz)	Power fed onto reference dipole (mW)	Targeted SAR _{10g} (W/kg)	Measured SAR _{10g} (W/kg)	Normalized SAR _{10g} (W/kg)	Deviation (%)
Feb. 12, 2013	2450	250	25.6	6.25	25	-2.34
Feb. 14, 2013	5200	100	22.8	2.32	23.2	1.75

Table 8.1 Target and Measurement SAR after Normalized

9. DUT Testing Position

9.1 Body-Supported Position

This DUT was tested in seven different positions. They are Bottom of Laptop with phantom 0 cm gap, Bottom of Tablet with phantom 0 cm gap, Back of Panel with phantom 2.5 cm gap, Edge1 with phantom 0 cm gap, Edge2 with phantom 0 cm gap, Edge3 with phantom 0 cm gap, and Edge4 with phantom 0 cm gap. In these positions, the antenna of the DUT can be rotated through 0 degree or 180 degrees during the test. The illustrations for lap-touching position are as below.

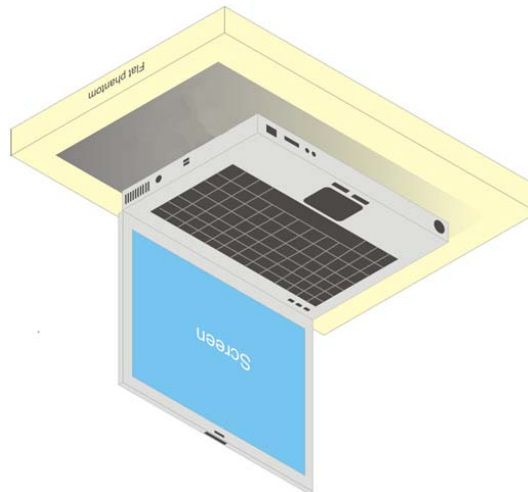


Fig 9.1 Illustration for Laptop PC on Lap-touching Position

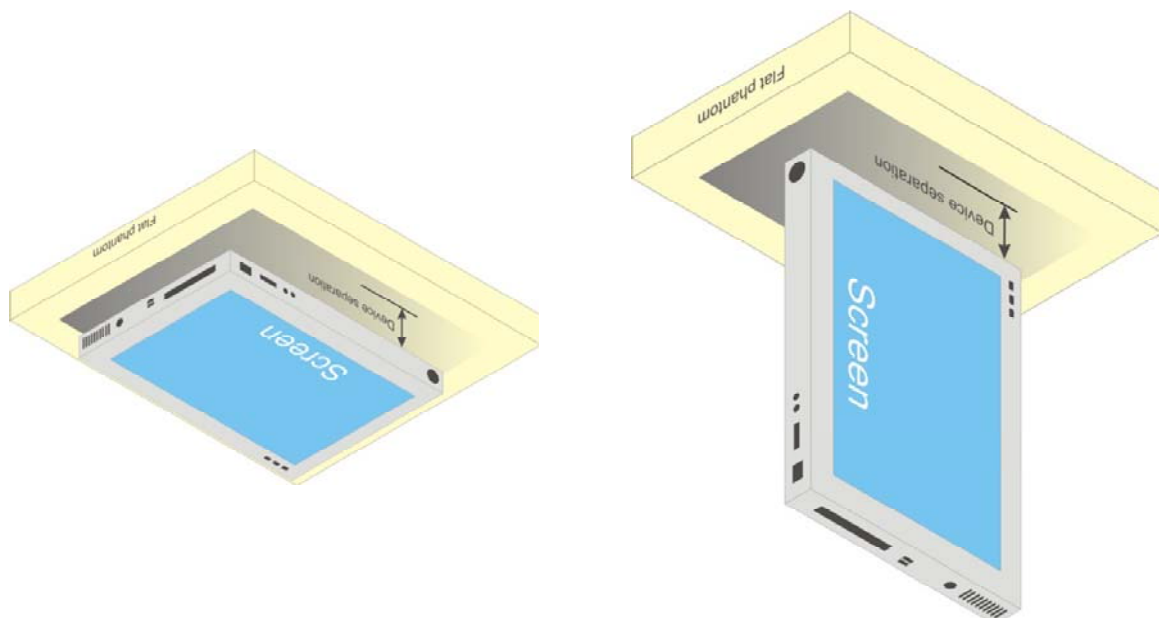


Fig 9.2 Illustration for Tablet PC on Lap-touching Position

<DUT Setup Photos>



Fig 9.3 Bottom of Laptop with Phantom 0 cm Gap – Antenna Position 0°



Fig 9.4 Bottom of Laptop with Phantom 0 cm – Antenna Position 180°



Fig 9.5 Bottom of Tablet with Phantom 0 cm – Antenna Position 0°



Fig 9.6 Bottom of Tablet with Phantom 0 cm – Antenna Position 180°



Fig 9.7 Back of Panel with Phantom 2.5 cm – Antenna Position 0°



Fig 9.8 Back of Panel with Phantom 2.5 cm – Antenna Position 180°



Fig 9.9 Edge1 with Phantom 0 cm – Antenna Position 0°



Fig 9.10 Edge1 with Phantom 0 cm – Antenna Position 180°



Fig 9.11 Edge2 with Phantom 0 cm – Antenna Position 180°



Fig 9.12 Edge3 with Phantom 0 cm – Antenna Position 180°



Fig 9.13 Edge4 with Phantom 0 cm – Antenna Position 180°

10. Measurement Procedures

The measurement procedures are as follows:

- (a) Use base station simulator (if applicable) or engineering software to transmit RF power continuously (continuous Tx) in the middle channel.
- (b) Keep DUT to radiate maximum output power or 100% duty factor (if applicable)
- (c) Measure output power through RF cable and power meter.
- (d) Place the DUT in the positions as setup photos demonstrates.
- (e) Set scan area, grid size and other setting on the DASY software.
- (f) Taking data for the middle channel on each testing position.
- (g) Find out the largest SAR result on these testing positions of each band.
- (h) Measure SAR results for the lowest and highest channels in worst SAR testing position.

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

10.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g

10.2 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

10.3 SAR Averaged Methods

In DASy, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

10.4 Power Drift Monitoring

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASy measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drift more than 5%, the SAR will be retested.

11. SAR Test Results

11.1 Conducted Power (Unit: dBm)

<WLAN 2.4GHz>

Mode	Channel	Frequency (MHz)	Average Power (dBm)			
			Data Rate (bps)			
			1M	2M	5.5M	11M
802.11b	CH01	2412	12.18	11.74	11.64	11.58
	CH07	2442	12.48	12.42	12.34	12.44
	CH13	2472	12.52	12.45	12.46	12.48

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			6M	9M	12M	18M	24M	36M	48M	54M
802.11g	CH01	2412	11.20	10.99	10.98	11.14	11.08	10.98	10.92	10.74
	CH07	2442	12.48	12.42	12.39	12.36	12.34	12.28	12.04	12.23
	CH13	2472	12.38	12.12	12.17	12.35	12.32	12.24	9.18	11.85

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			6M	9M	12M	18M	24M	36M	48M	54M
802.11n-HT20	CH01	2412 MHz	11.48	11.44	11.25	11.08	10.98	11.04	10.95	10.89
	CH07	2442 MHz	12.71	12.54	12.48	12.35	12.18	12.08	11.92	11.88
	CH13	2472 MHz	12.28	12.22	12.19	12.10	12.24	12.22	12.18	11.93

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			6.5M	13M	19.5M	26M	39M	52M	58.5M	65M
802.11n-HT40	CH03	2422	11.72	11.24	11.15	11.08	11.13	11.17	11.21	11.26
	CH07	2442	12.74	12.53	11.93	11.89	12.31	12.38	12.32	12.22
	CH11	2462	13.06	12.82	13.12	12.72	12.77	12.62	13.13	13.17

Note: Choose the highest output power modulation 11n-HT40 to test SAR and determine further SAR exclusion.

<Bluetooth>

Mode	Channel	Frequency (MHz)	Average Power (dBm)								
			Data Rate								
			DH1	DH3	DH5	2DH1	2DH3	2DH5	3DH1	3DH3	3DH5
Bluetooth	CH 00	2402	-1.32	-1.27	-0.87	-4.87	-5.03	-4.89	-4.56	-4.73	-4.61
	CH 39	2441	-0.28	0.72	1.00	-3.84	-3.93	-4.05	-3.63	-3.92	-3.79
	CH 78	2480	0.43	0.77	1.16	-3.34	-3.65	-3.70	-3.67	-3.84	-3.85

Note: Bluetooth SAR is compliant, because the output power of Bluetooth device is less than 20mW (13dBm), and standalone SAR is exempt per EN62479.

<WLAN 5GHz>

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
802.11a	CH36	5180	11.90	11.84	11.87	11.87	11.84	11.95	11.54	11.57
	CH44	5220	12.52	12.48	12.55	12.68	12.84	13.15	13.04	13.27
	CH48	5240	13.28	13.13	13.24	13.18	13.08	12.68	12.64	12.59

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			6.5 Mbps	13 Mbps	19.5 Mbps	26 Mbps	39 Mbps	52 Mbps	58.5 Mbps	65 Mbps
802.11n-HT20	CH36	5180	13.31	13.27	13.04	12.98	13.04	13.09	13.07	13.02
	CH44	5220	13.22	13.18	13.08	13.02	12.98	12.94	12.89	12.87
	CH48	5240	13.08	13.04	12.98	12.88	12.97	12.78	12.68	12.64

Mode	Channel	Frequency (MHz)	Average Power (dBm)							
			Data Rate (bps)							
			13.5 M bps	27 M bps	40.5 M bps	54 M bps	81 M bps	108 M bps	121.5 M bps	135 M bps
802.11n-HT40	CH 38	5190 MHz	13.17	13.11	13.12	13.08	13.12	13.11	13.14	13.09
	CH 46	5230 MHz	12.98	12.93	12.94	12.84	12.72	12.68	12.64	12.62

Note: Choose the highest output power modulation 11n-HT20 at middle channel to test SAR and determine the worst-configuration for further high/low channel tests.

11.2 Test Records for Body SAR Test

<WLAN 2.4GHz>

Plot No.	Band	Mode	Test Position	Gap (cm)	DUT Mode	Antenna Position	Ch.	SAR _{10g} (W/kg)
#01	WLAN 2.4GHz	802.11n-HT40	Bottom of Laptop	0	Laptop PC	0°	7	0.019
#02	WLAN 2.4GHz	802.11n-HT40	Bottom of Laptop	0	Laptop PC	180°	7	0.014
#03	WLAN 2.4GHz	802.11n-HT40	Back of Panel	2.5	Laptop PC	0°	7	0.047
#04	WLAN 2.4GHz	802.11n-HT40	Back of Panel	2.5	Laptop PC	180°	7	0.053
#05	WLAN 2.4GHz	802.11n-HT40	Bottom of Tablet	0	Tablet PC	0°	7	0.014
#06	WLAN 2.4GHz	802.11n-HT40	Bottom of Tablet	0	Tablet PC	180°	7	0.089
#07	WLAN 2.4GHz	802.11n-HT40	Edge1	0	Tablet PC	0°	7	0.00646
#08	WLAN 2.4GHz	802.11n-HT40	Edge1	0	Tablet PC	180°	7	0.02
#09	WLAN 2.4GHz	802.11n-HT40	Edge2	0	Tablet PC	180°	7	0.00797
#10	WLAN 2.4GHz	802.11n-HT40	Edge3	0	Tablet PC	180°	7	0.000362
#11	WLAN 2.4GHz	802.11n-HT40	Edge4	0	Tablet PC	180°	7	0.302
#12	WLAN 2.4GHz	802.11n-HT40	Edge4	0	Tablet PC	180°	3	0.207
#13	WLAN 2.4GHz	802.11n-HT40	Edge4	0	Tablet PC	180°	11	0.249

<WLAN 5GHz>

Plot No.	Band	Mode	Test Position	Gap (cm)	DUT Mode	Antenna Position	Ch.	SAR _{10g} (W/kg)
#14	WLAN 5GHz	802.11n-HT20	Bottom of Laptop	0	Laptop PC	0°	44	0.00308
#15	WLAN 5GHz	802.11n-HT20	Bottom of Laptop	0	Laptop PC	180°	44	0.00599
#16	WLAN 5GHz	802.11n-HT20	Back of Panel	2.5	Laptop PC	0°	44	0.00648
#17	WLAN 5GHz	802.11n-HT20	Back of Panel	2.5	Laptop PC	180°	44	0.018
#18	WLAN 5GHz	802.11n-HT20	Bottom of Tablet	0	Tablet PC	0°	44	0.072
#19	WLAN 5GHz	802.11n-HT20	Bottom of Tablet	0	Tablet PC	180°	44	0.073
#20	WLAN 5GHz	802.11n-HT20	Edge1	0	Tablet PC	0°	44	0.00239
#21	WLAN 5GHz	802.11n-HT20	Edge1	0	Tablet PC	180°	44	0.016
#22	WLAN 5GHz	802.11n-HT20	Edge2	0	Tablet PC	180°	44	0.000917
#23	WLAN 5GHz	802.11n-HT20	Edge3	0	Tablet PC	180°	44	0.000102
#24	WLAN 5GHz	802.11n-HT20	Edge4	0	Tablet PC	180°	44	0.036
#25	WLAN 5GHz	802.11n-HT20	Bottom of Tablet	0	Tablet PC	180°	36	0.064
#26	WLAN 5GHz	802.11n-HT20	Bottom of Tablet	0	Tablet PC	180°	48	0.037



11.3 Simultaneous Multi-band Transmission

No.	Applicable Simultaneous Transmission Combination
1	WLAN + Bluetooth

Note:

1. When stand-alone SAR is not required for a transmitter or antenna, its SAR is considered zero in the SAR summing process to assess Multi-band transmission SAR compliance.
2. Bluetooth stand-alone SAR tests are not required and are considered zero in the SAR summation.
3. Multi-band transmission analysis for Body SAR is performed following EN 62209-2 procedure.

Test Engineer: Fulu Hu

12. References

- [1] Council Recommendation 1999/519/EC of July 1999 on the limitation of exposure of the general public to electromagnetic fields (0Hz to 300 GHz)
- [2] EN 62311, "Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0Hz – 300 GHz)", January 2008
- [3] EN 62209-2, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices. Human models, instrumentation, and procedures. Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", August 2010
- [4] EN 62479:2010 "Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)", December 2010
- [5] SPEAG DASY System Handbook



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Head_2450MHz_130212

DUT: D2450V2 - SN:736

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.809$ mho/m; $\epsilon_r =$

37.604 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.87, 6.87, 6.87); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.867 mW/g

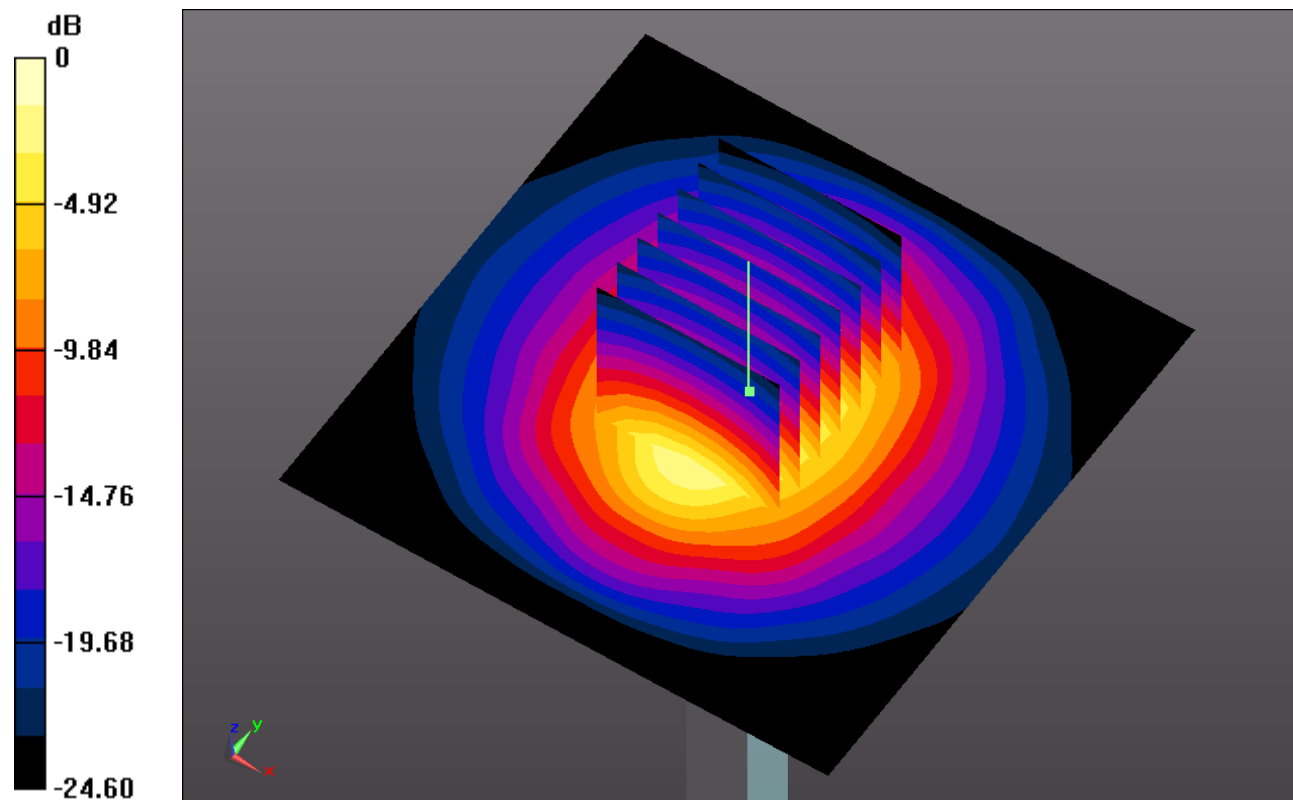
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.884 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 31.378 W/kg

SAR(1 g) = 14 mW/g; SAR(10 g) = 6.25 mW/g

Maximum value of SAR (measured) = 15.745 mW/g



0 dB = 15.750mW/g

System Check_Head_5200MHz_130214

DUT: D5GHzV2 - SN: 1006

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: HSL_5G_130214 Medium parameters used: $f = 5200$ MHz; $\sigma = 4.814$ mho/m; $\epsilon_r = 35.458$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Pin=100mW/Area Scan (71x71x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 19.203 mW/g

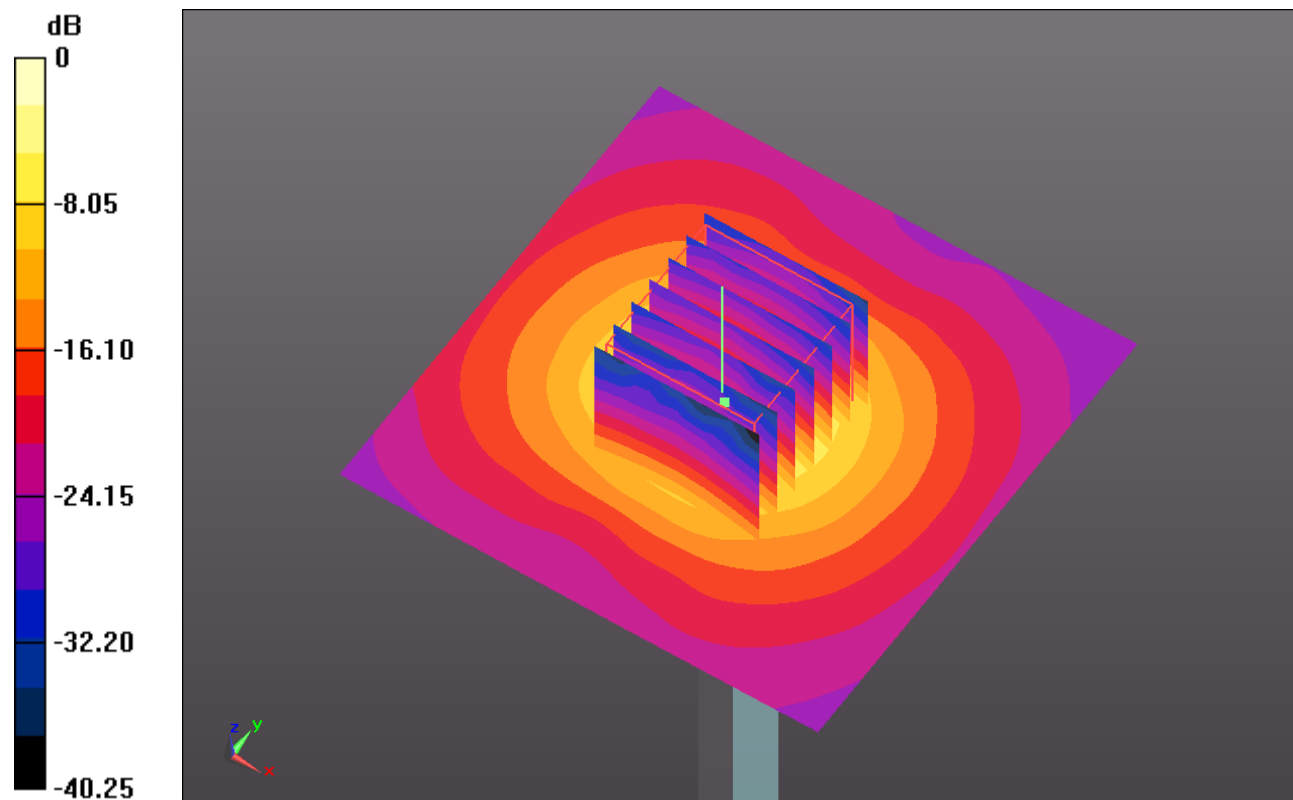
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 57.336 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.533 W/kg

SAR(1 g) = 8.2 mW/g; SAR(10 g) = 2.32 mW/g

Maximum value of SAR (measured) = 19.601 mW/g



0 dB = 19.600mW/g



Appendix B. Plots of SAR Measurement

The plots are shown as follows.

#01 WLAN 2.4GHz_802.11n-HT40_Bottom of Laptop_0cm_Laptop PC_Ant Degree 0_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.033 mW/g

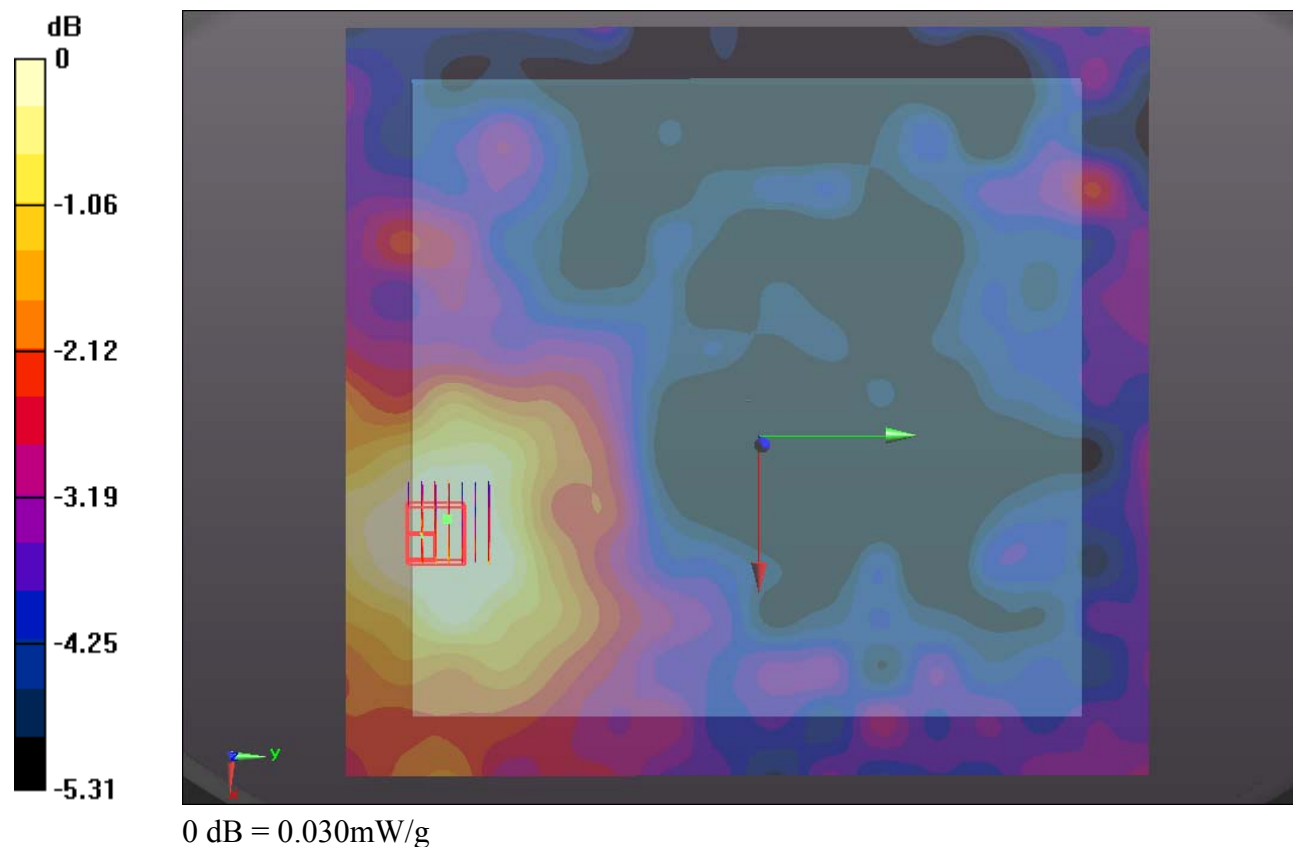
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.158 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.042 W/kg

SAR(1 g) = 0.023 mW/g; SAR(10 g) = 0.019 mW/g

Maximum value of SAR (measured) = 0.030 mW/g



#02 WLAN 2.4GHz_802.11n-HT40_Bottom of Laptop_0cm_Laptop PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (211x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.032 mW/g

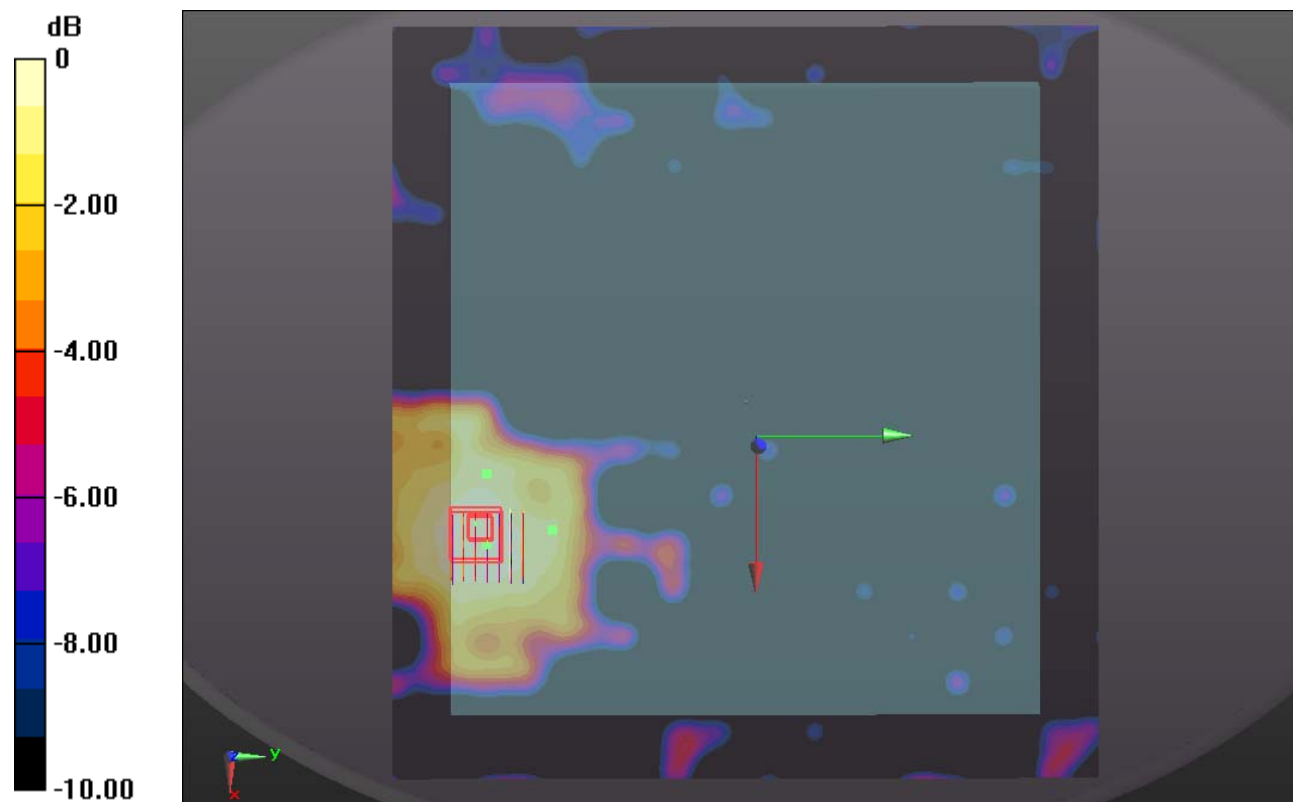
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.343 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.042 W/kg

SAR(1 g) = 0.021 mW/g; SAR(10 g) = 0.014 mW/g

Maximum value of SAR (measured) = 0.029 mW/g



0 dB = 0.030mW/g

#03 WLAN 2.4GHz_802.11n-HT40_Back of Panel_2.5cm_Laptop PC_Ant Degree 0_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.078 mW/g

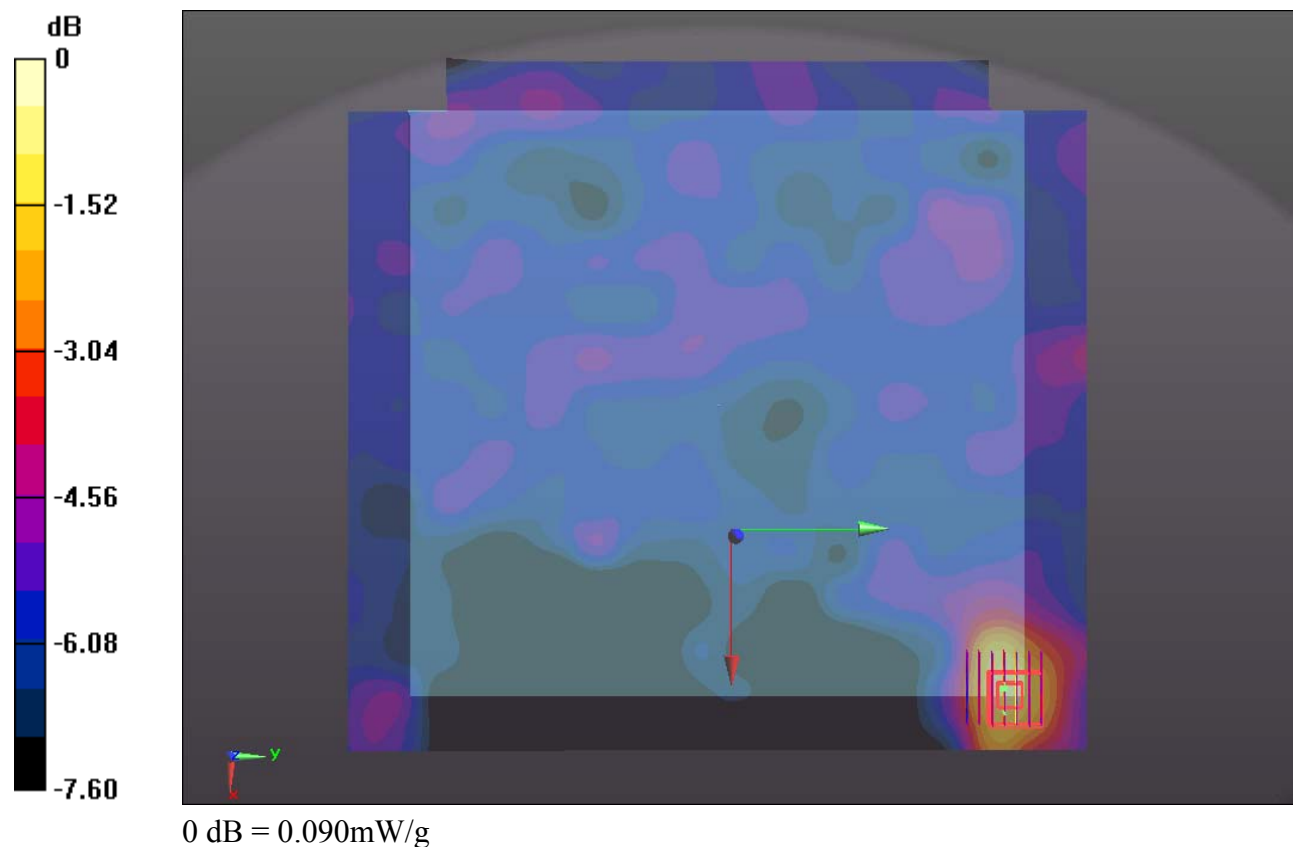
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.824 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.138 W/kg

SAR(1 g) = 0.069 mW/g; SAR(10 g) = 0.047 mW/g

Maximum value of SAR (measured) = 0.092 mW/g



#04 WLAN 2.4GHz_802.11n-HT40_Back of Panel_2.5cm_Laptop PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (211x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.121 mW/g

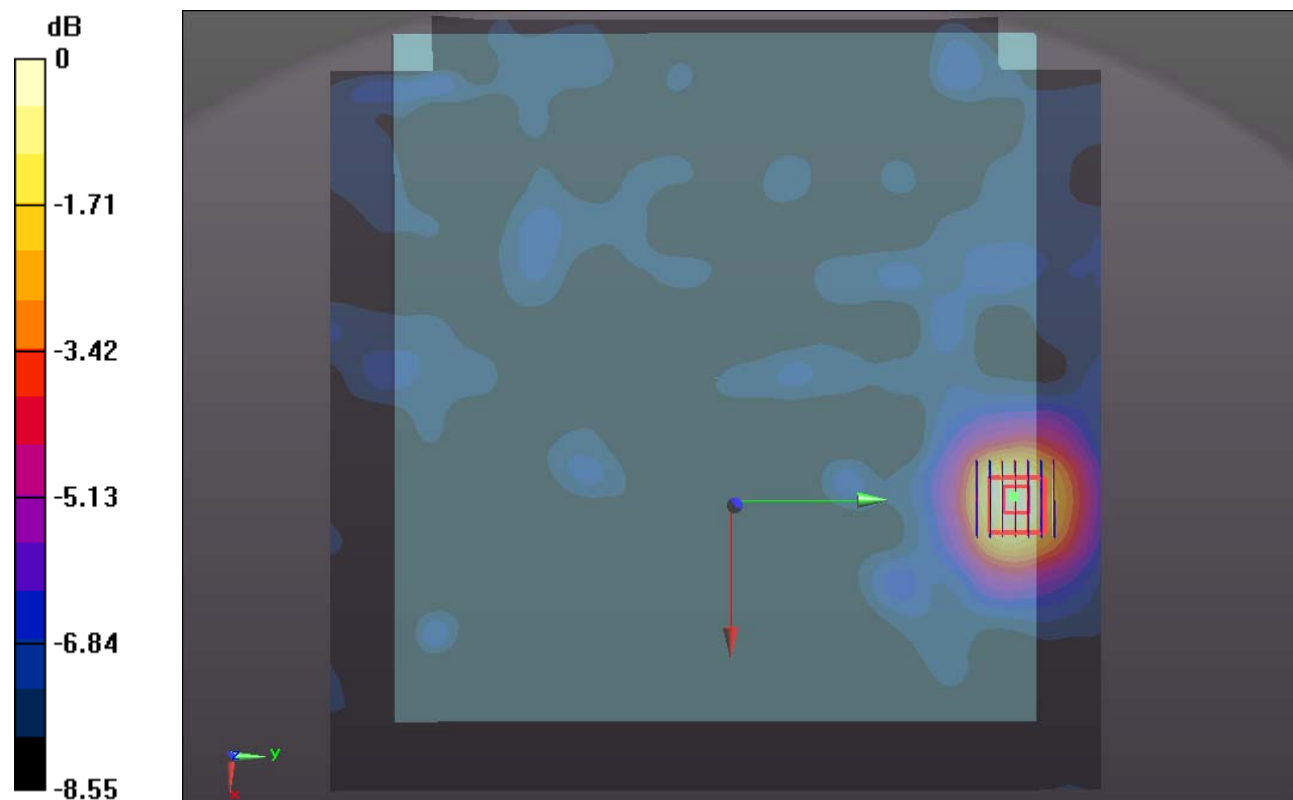
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.675 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.163 W/kg

SAR(1 g) = 0.087 mW/g; SAR(10 g) = 0.053 mW/g

Maximum value of SAR (measured) = 0.120 mW/g



0 dB = 0.120mW/g

#05 WLAN 2.4GHz_802.11n-HT40_Bottom of Tablet_0cm_Tablet PC_Ant Degree 0_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.028 mW/g

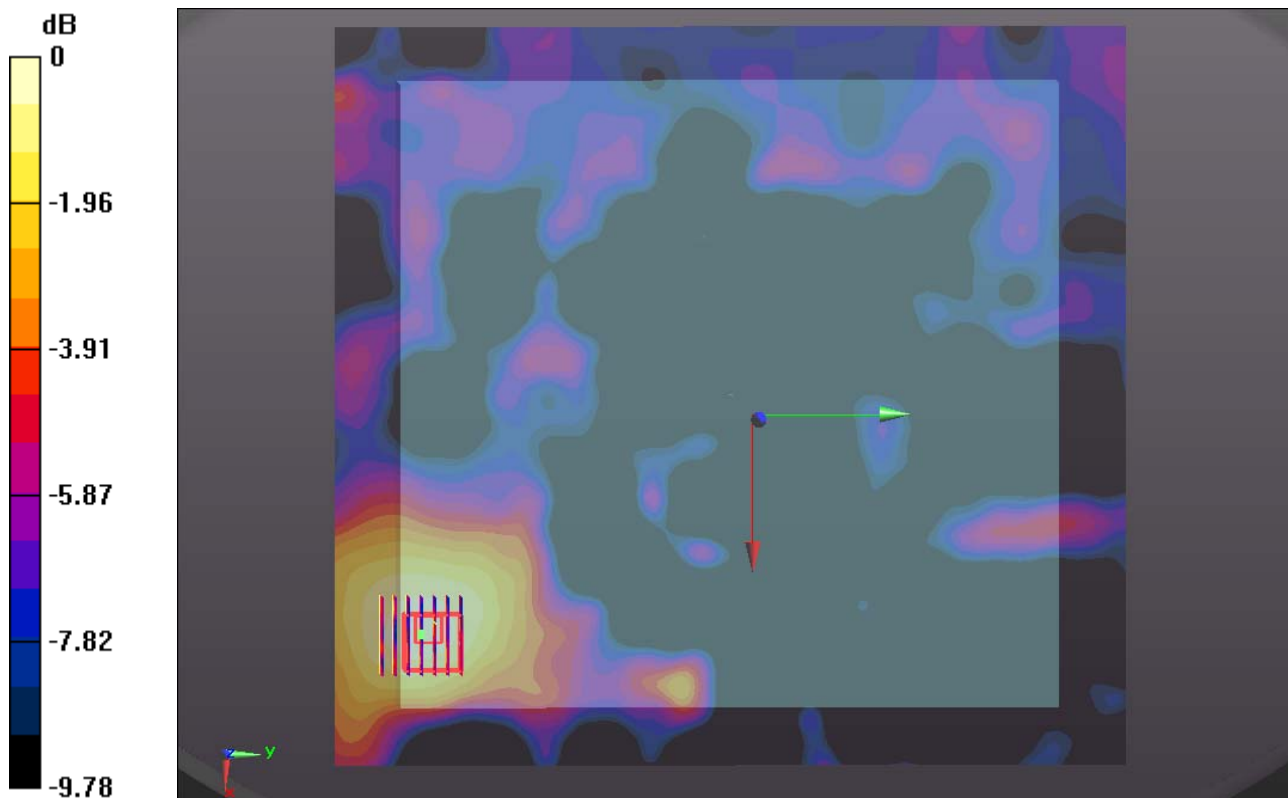
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.454 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.042 W/kg

SAR(1 g) = 0.021 mW/g; SAR(10 g) = 0.014 mW/g

Maximum value of SAR (measured) = 0.032 mW/g



0 dB = 0.030mW/g

#06 WLAN 2.4GHz_802.11n-HT40_Bottom of Tablet_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (181x201x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.213 mW/g

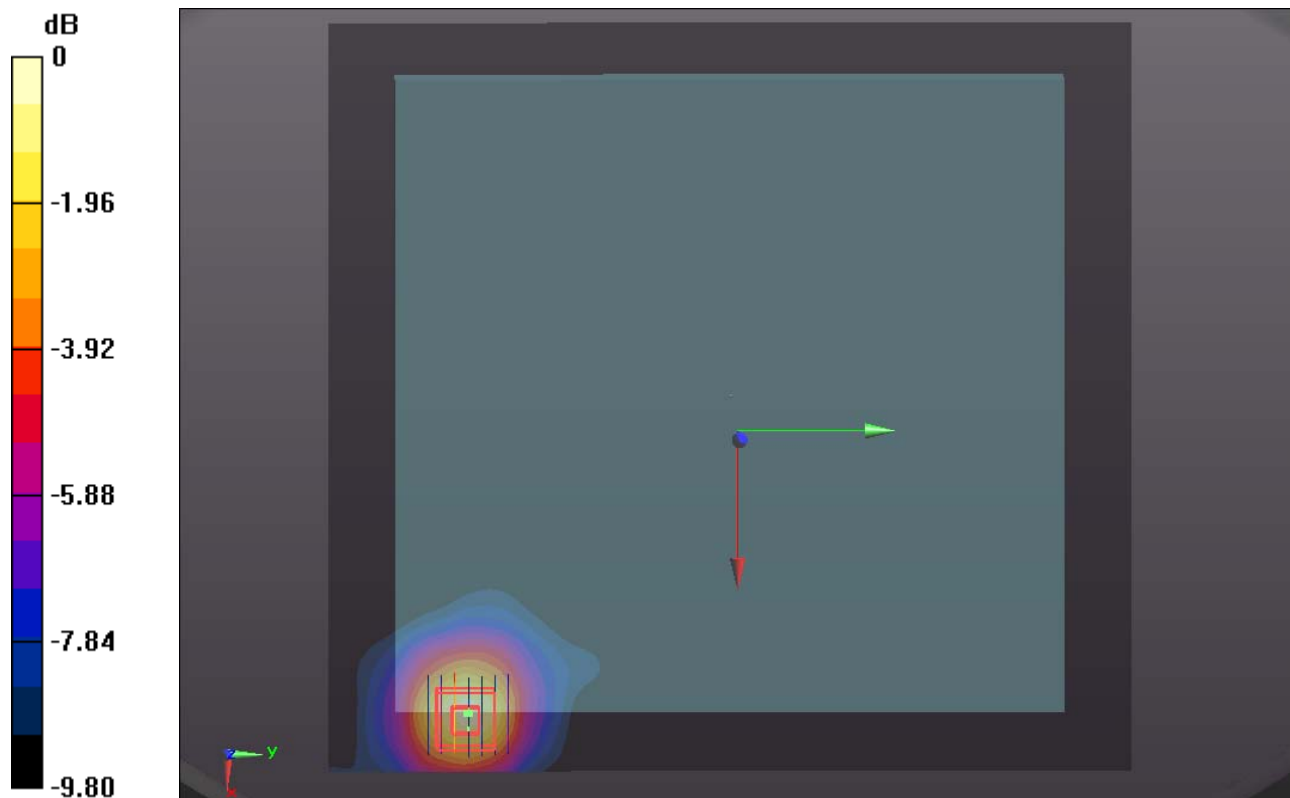
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 2.556 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.331 W/kg

SAR(1 g) = 0.161 mW/g; SAR(10 g) = 0.089 mW/g

Maximum value of SAR (measured) = 0.231 mW/g



0 dB = 0.230mW/g

#07 WLAN 2.4GHz_802.11n-HT40_Edge 1_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (61x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.012 mW/g

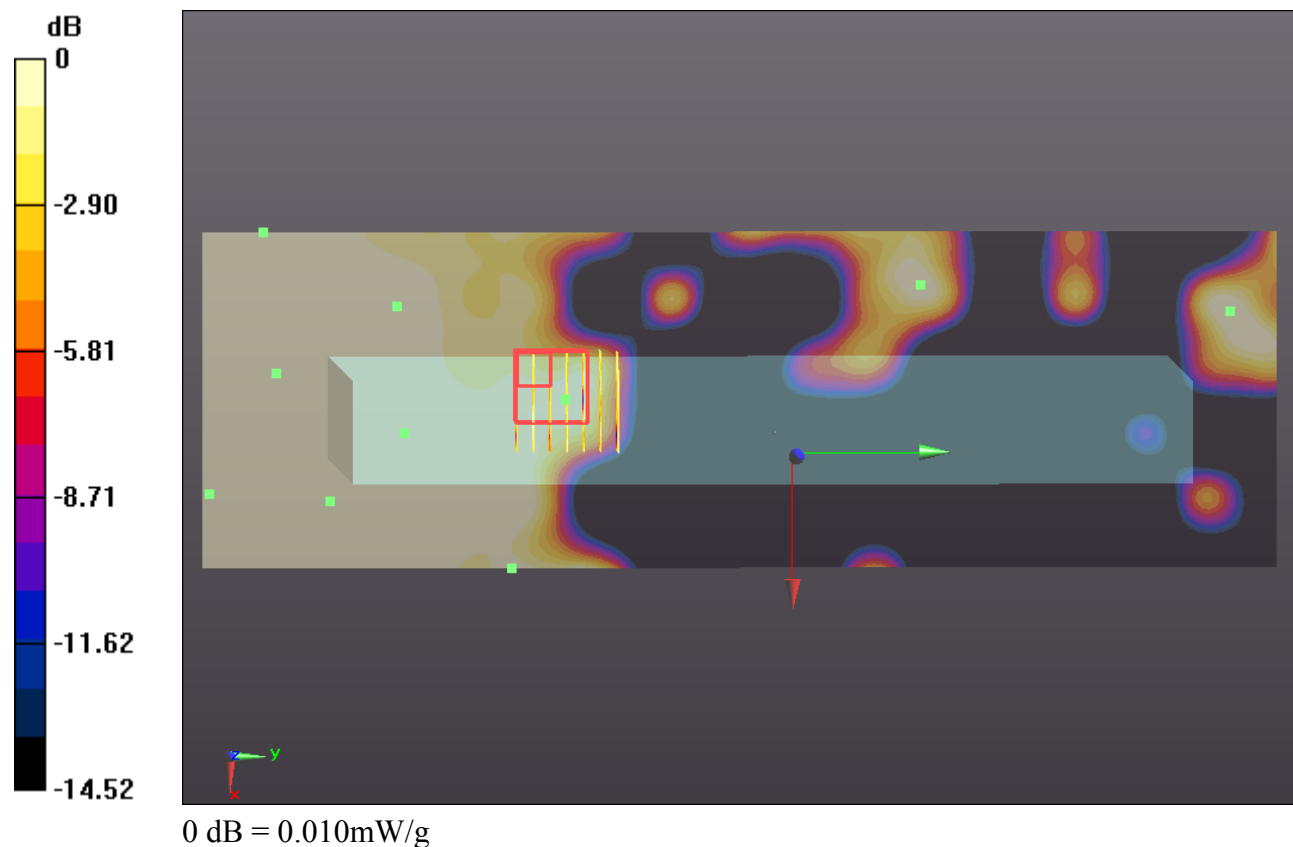
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.041 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.014 W/kg

SAR(1 g) = 0.00785 mW/g; SAR(10 g) = 0.00646 mW/g

Maximum value of SAR (measured) = 0.011 mW/g



#08 WLAN 2.4GHz_802.11n-HT40_Edge 1_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (61x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.053 mW/g

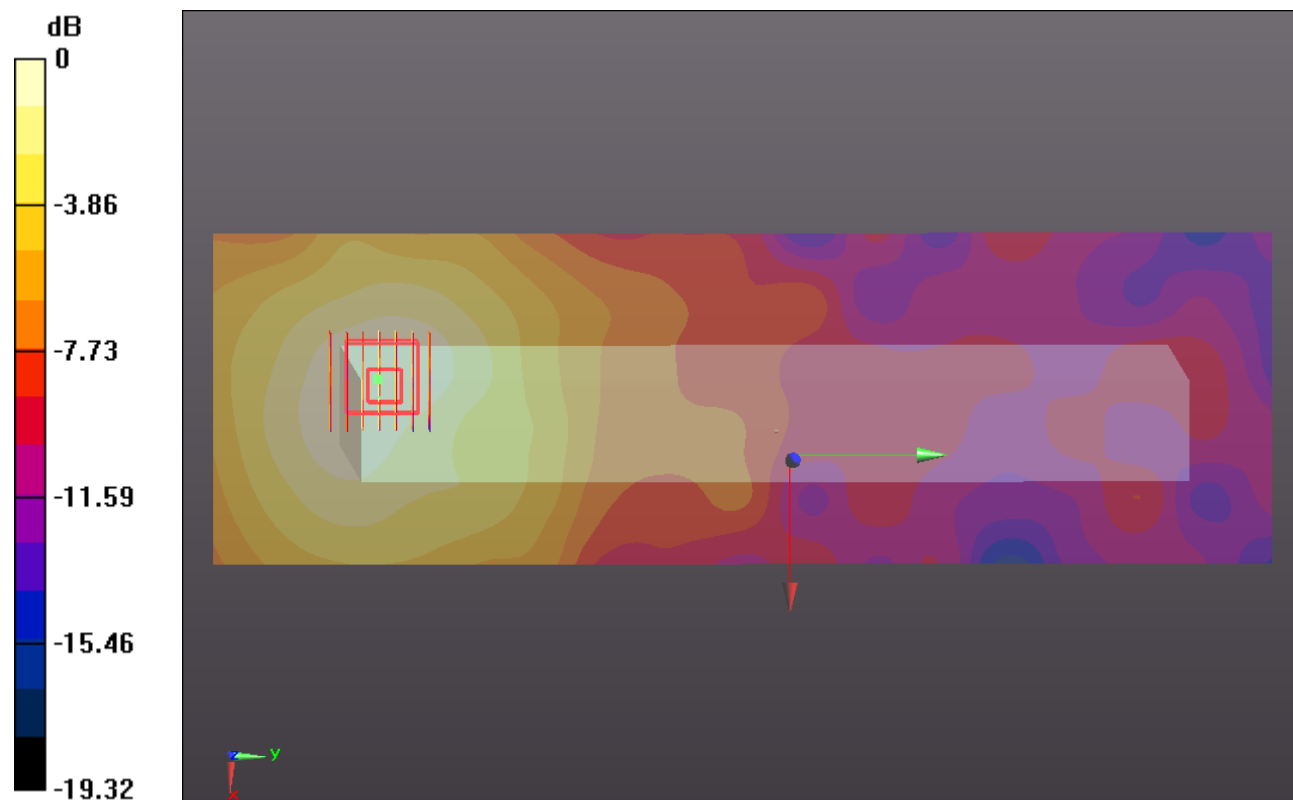
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.258 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.071 W/kg

SAR(1 g) = 0.035 mW/g; SAR(10 g) = 0.020 mW/g

Maximum value of SAR (measured) = 0.051 mW/g



0 dB = 0.050mW/g

#09 WLAN 2.4GHz_802.11n-HT40_Edge 2_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (51x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.015 mW/g

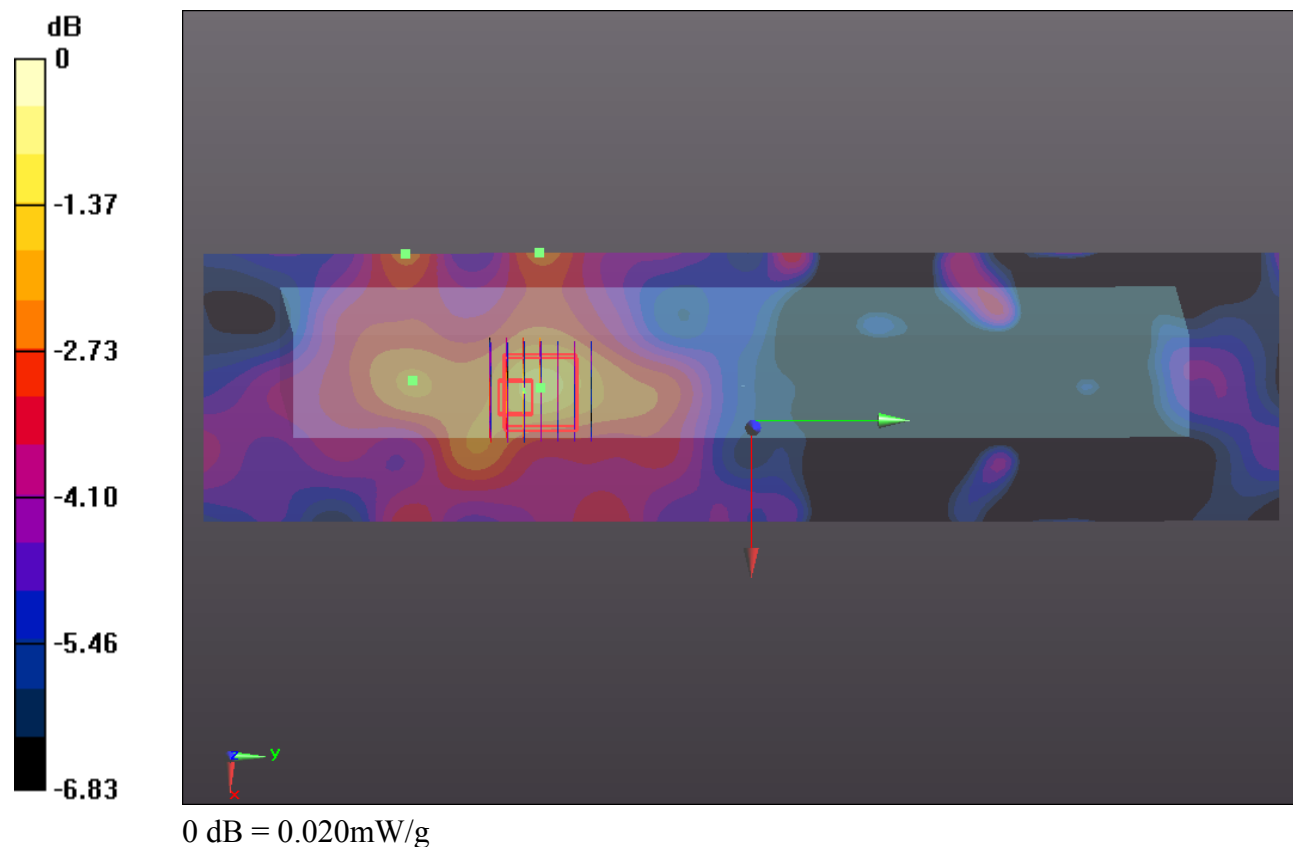
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.900 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 0.032 W/kg

SAR(1 g) = 0.011 mW/g; SAR(10 g) = 0.00797 mW/g

Maximum value of SAR (measured) = 0.016 mW/g



#10 WLAN 2.4GHz_802.11n-HT40_Edge 3_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (91x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.00671 mW/g

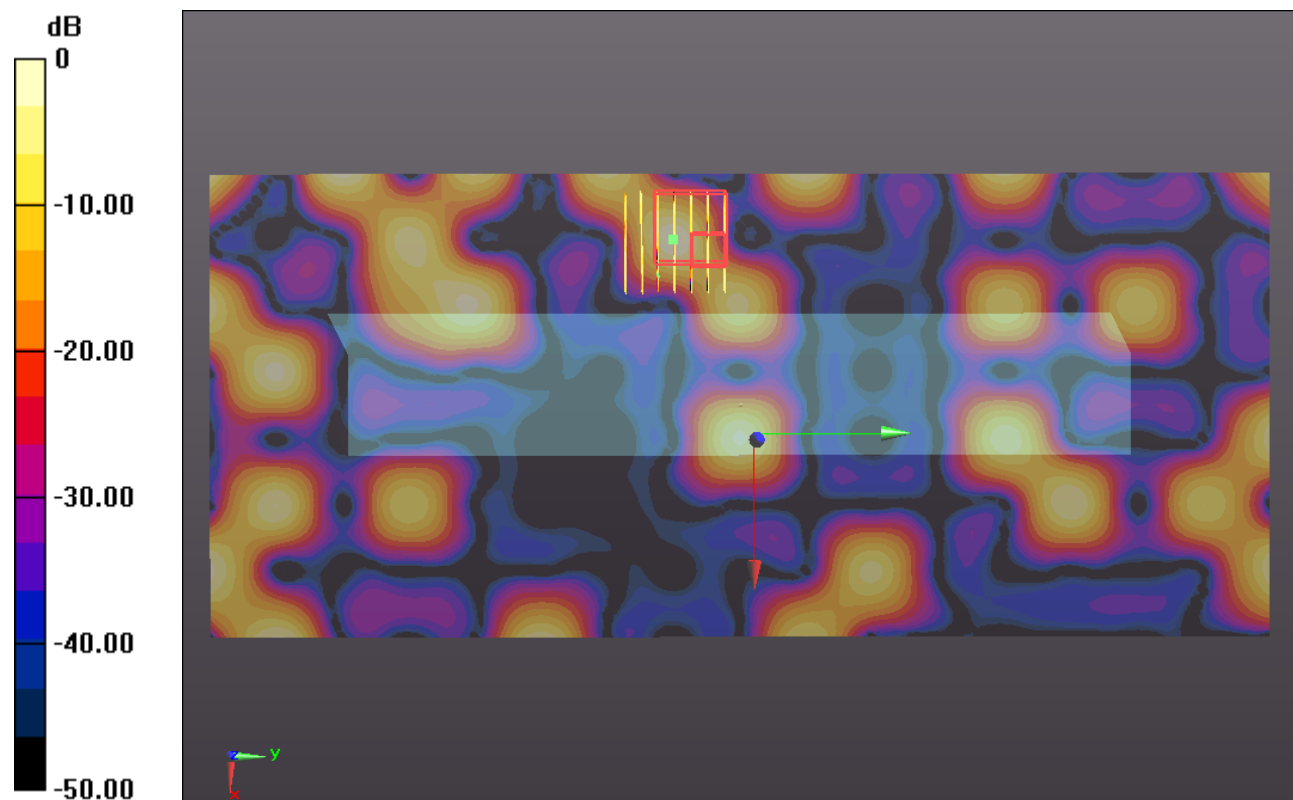
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.00841 W/kg

SAR(1 g) = 0.000922 mW/g; SAR(10 g) = 0.000362 mW/g

Maximum value of SAR (measured) = 0.00663 mW/g



0 dB = 0.0066mW/g

#11 WLAN 2.4GHz_802.11n-HT40_Edge 4_0cm_Tablet PC_Ant Degree 180_7

DUT: 2D1707

Communication System: WIFI; Frequency: 2442 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2442$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r =$

53.479 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch7/Area Scan (51x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.452 mW/g

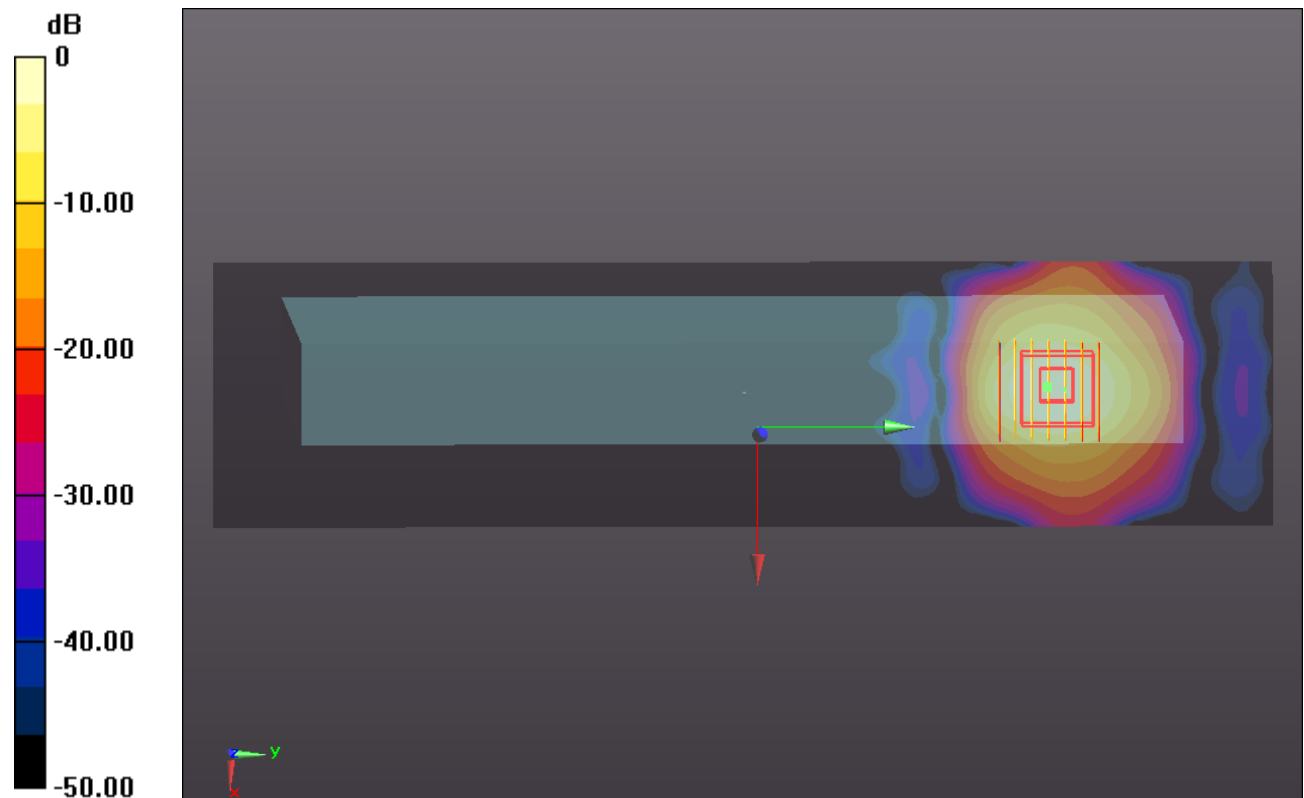
Ch7/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.782 W/kg

SAR(1 g) = 0.718 mW/g; SAR(10 g) = 0.302 mW/g

Maximum value of SAR (measured) = 1.162 mW/g



0 dB = 1.160mW/g

#12 WLAN 2.4GHz_802.11n-HT40_Edge 4_0cm_Tablet PC_Ant Degree 180_3

DUT: 2D1707

Communication System: WIFI; Frequency: 2422 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2422$ MHz; $\sigma = 1.949$ mho/m; $\epsilon_r =$

53.513 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch3/Area Scan (51x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.216 mW/g

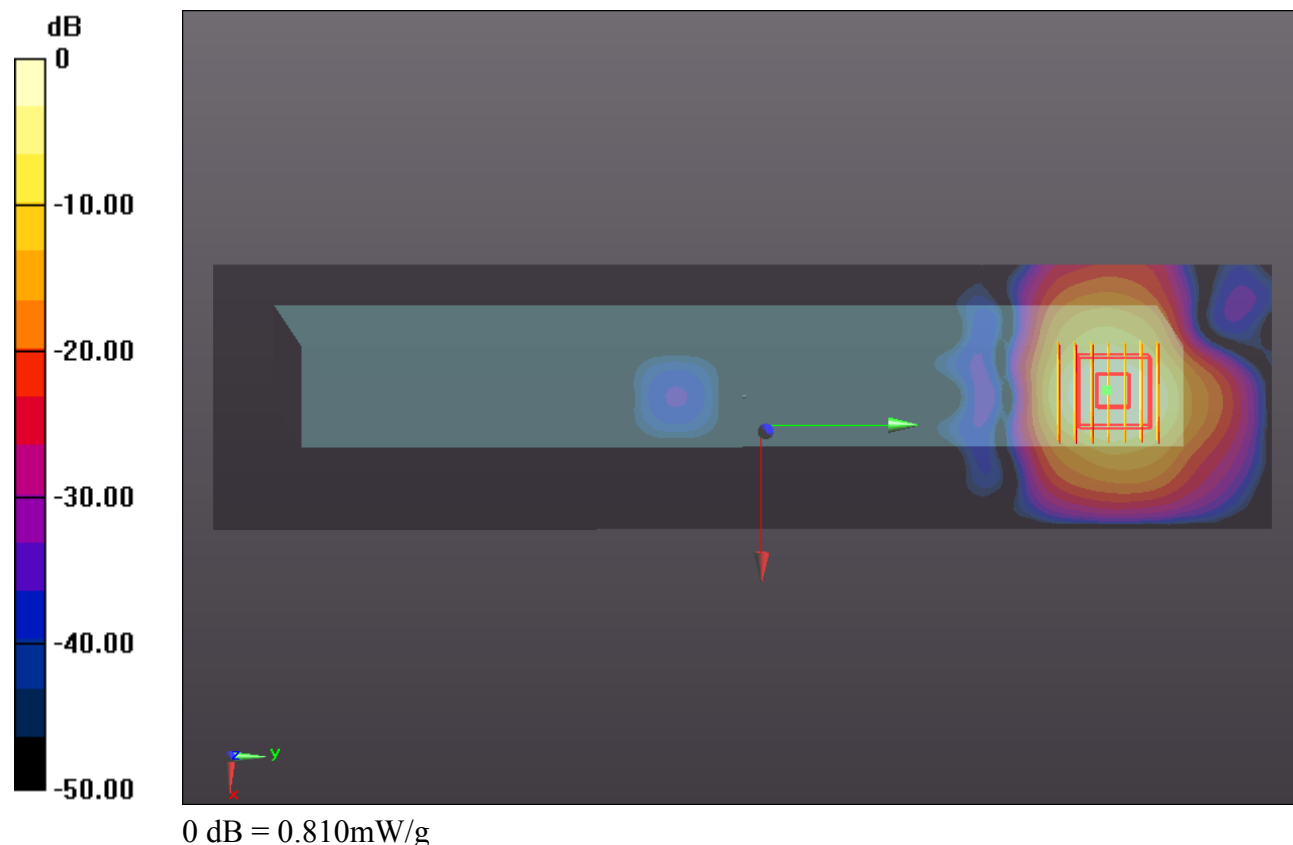
Ch3/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0.425 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.230 W/kg

SAR(1 g) = 0.493 mW/g; SAR(10 g) = 0.207 mW/g

Maximum value of SAR (measured) = 0.814 mW/g



#13 WLAN 2.4GHz_802.11n-HT40_Edge 4_0cm_Tablet PC_Ant Degree 180_11

DUT: 2D1707

Communication System: WIFI; Frequency: 2462 MHz; Duty Cycle: 1:1

Medium: HSL_2450_130212 Medium parameters used: $f = 2462$ MHz; $\sigma = 2.027$ mho/m; $\epsilon_r =$

53.408 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.1 °C ; Liquid Temperature : 21.2 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(6.94, 6.94, 6.94); Calibrated: 2012-6-20

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch11/Area Scan (51x211x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.181 mW/g

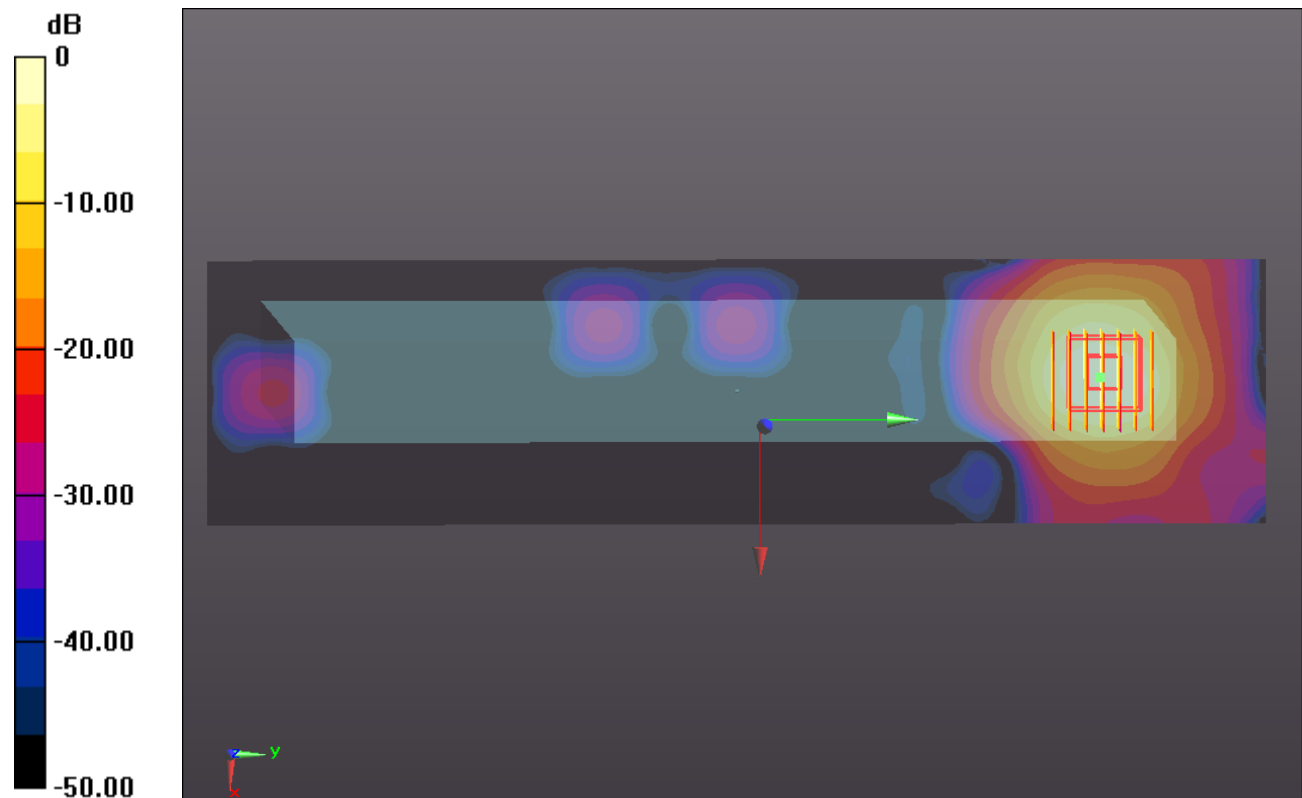
Ch11/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 1.486 W/kg

SAR(1 g) = 0.593 mW/g; SAR(10 g) = 0.249 mW/g

Maximum value of SAR (measured) = 0.954 mW/g



0 dB = 0.950mW/g

#14 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Laptop PC_Ant Degree 0_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (281x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.030 mW/g

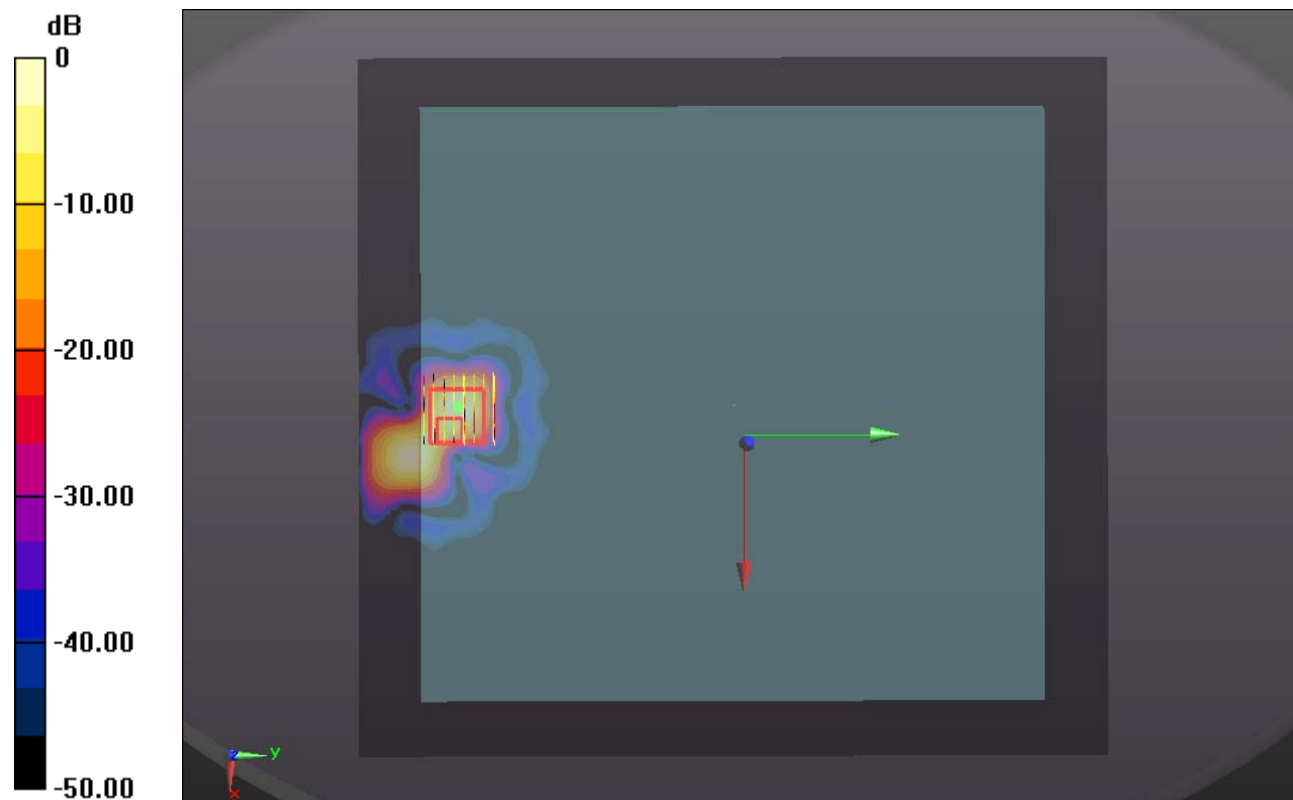
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.152 W/kg

SAR(1 g) = 0.00981 mW/g; SAR(10 g) = 0.00308 mW/g

Maximum value of SAR (measured) = 0.031 mW/g



0 dB = 0.030mW/g

#15 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Laptop PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (281x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.073 mW/g

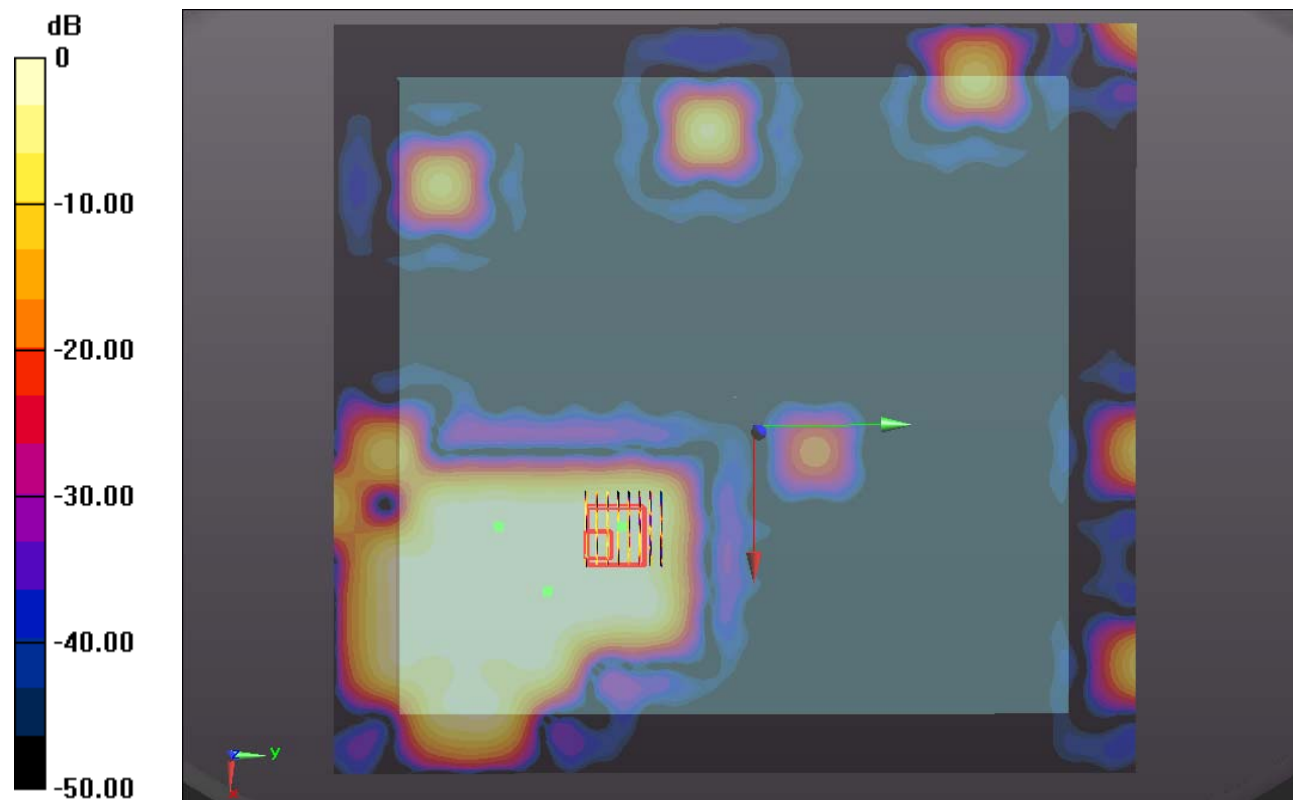
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 0.188 W/kg

SAR(1 g) = 0.015 mW/g; SAR(10 g) = 0.00599 mW/g

Maximum value of SAR (measured) = 0.053 mW/g



0 dB = 0.050mW/g

#16 WLAN 5GHz_802.11n-HT20_Back of Panel_2.5cm_Laptop PC_Ant Degree 0_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (281x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.037 mW/g

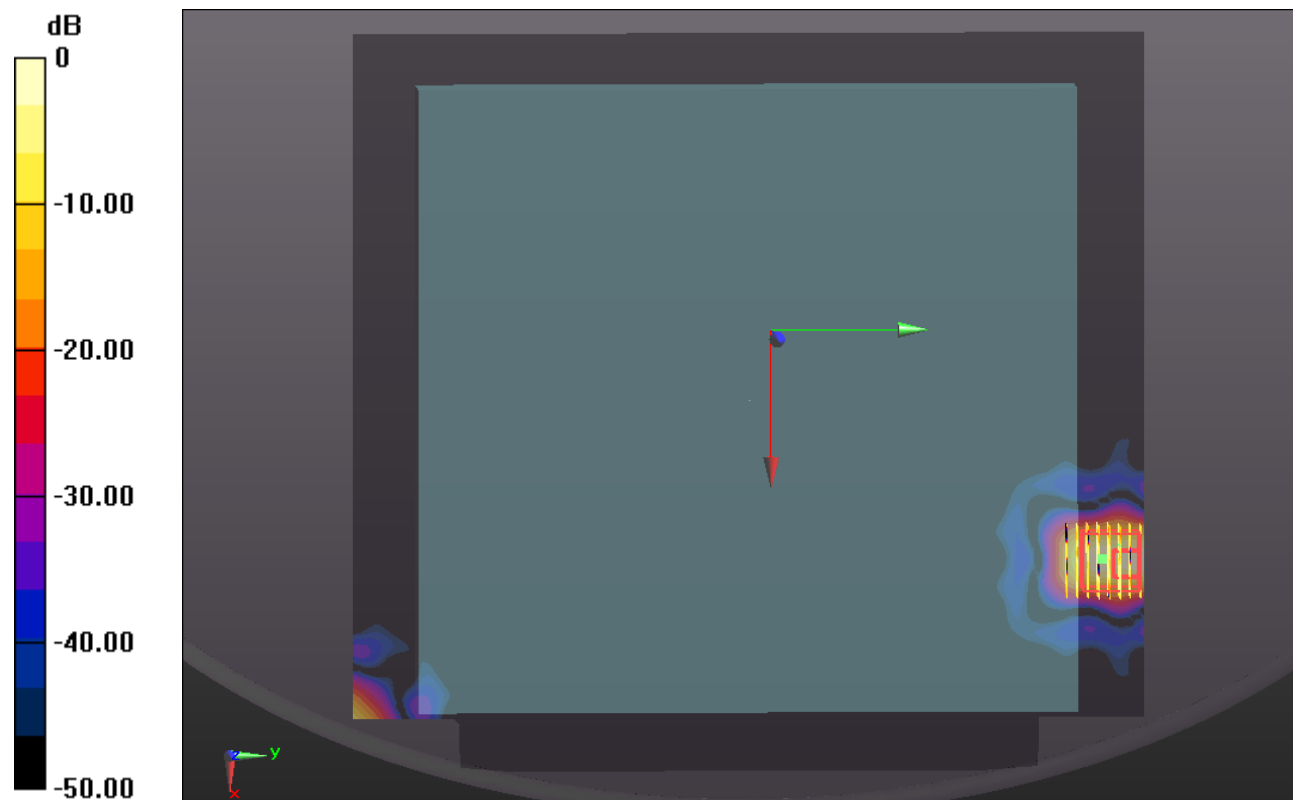
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0.773 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.094 W/kg

SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00648 mW/g

Maximum value of SAR (measured) = 0.044 mW/g



0 dB = 0.040mW/g

#17 WLAN 5GHz_802.11n-HT20_Back of Panel_2.5cm_Laptop PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (321x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.170 mW/g

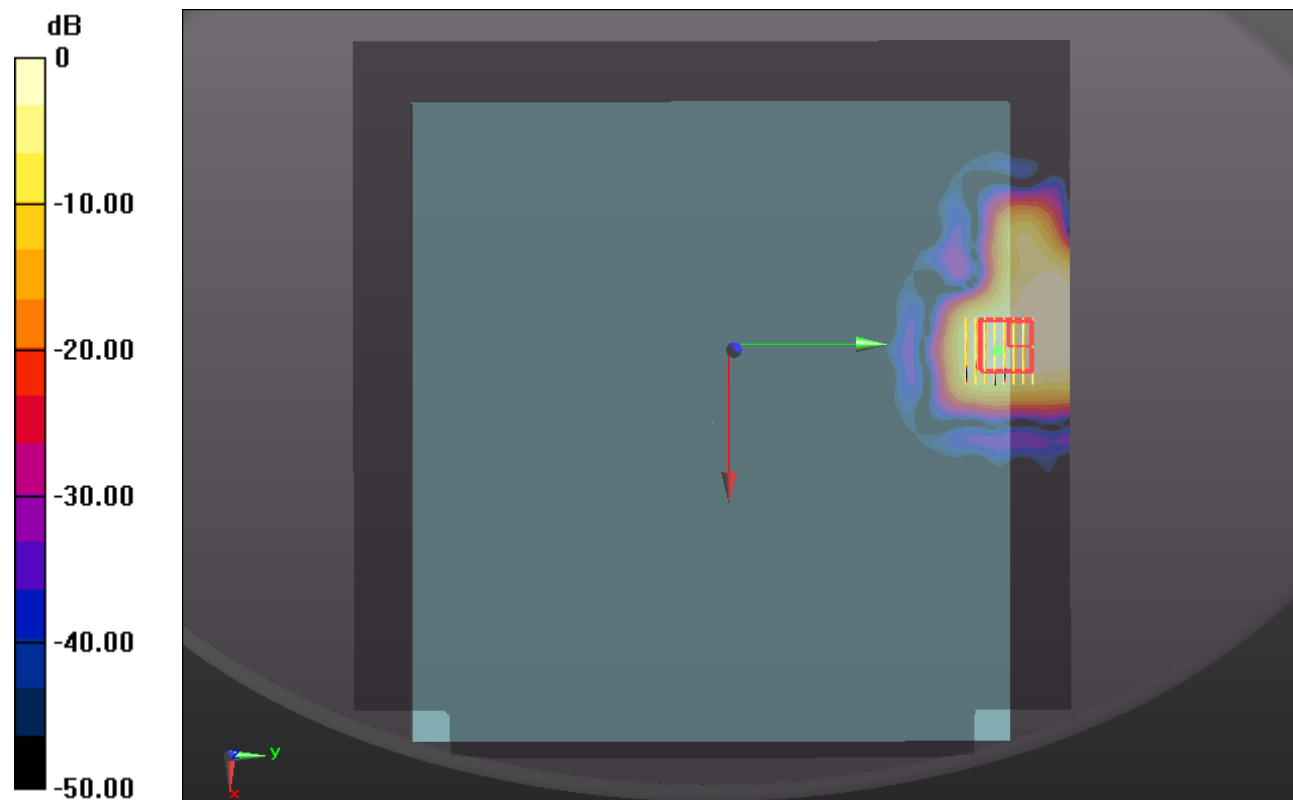
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.152 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 0.155 W/kg

SAR(1 g) = 0.049 mW/g; SAR(10 g) = 0.018 mW/g

Maximum value of SAR (measured) = 0.105 mW/g



0 dB = 0.110mW/g

#18 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Tablet PC_Ant Degree 0_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (281x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.207 mW/g

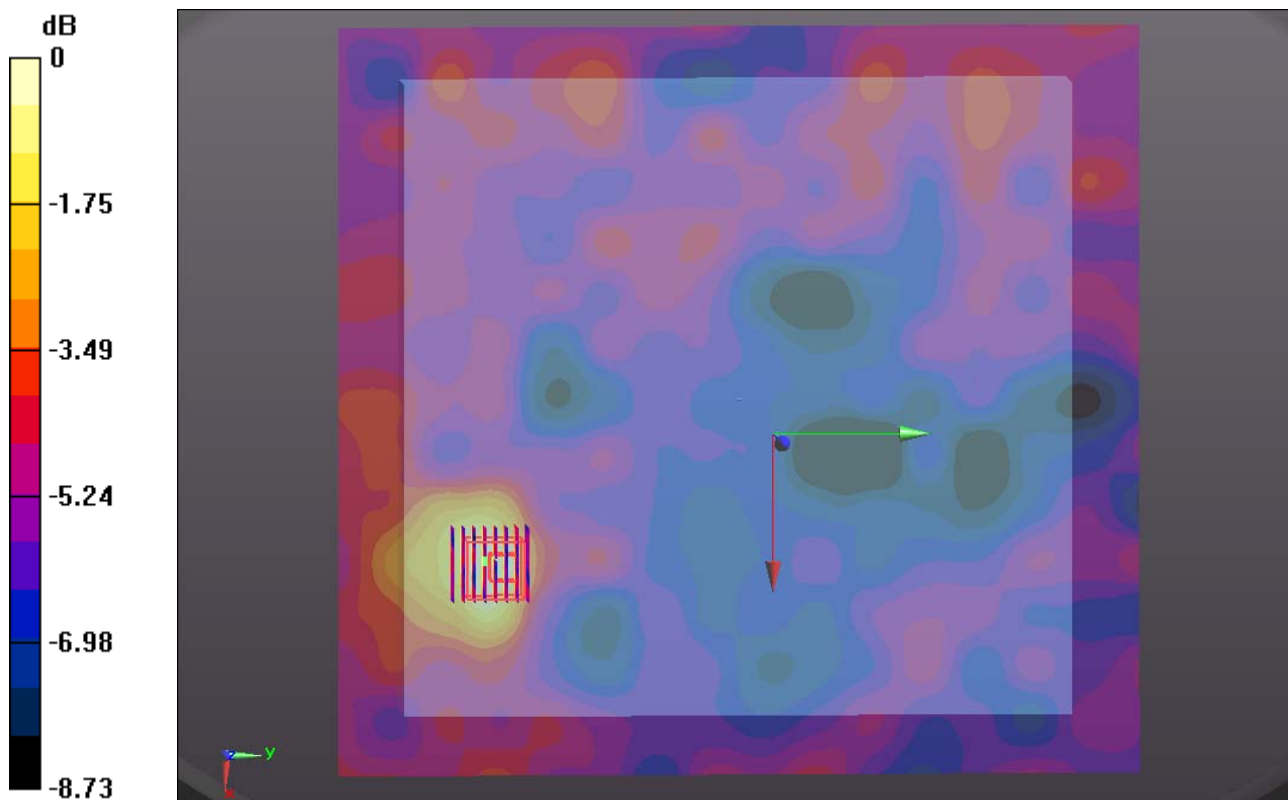
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.893 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.303 W/kg

SAR(1 g) = 0.107 mW/g; SAR(10 g) = 0.072 mW/g

Maximum value of SAR (measured) = 0.177 mW/g



0 dB = 0.180mW/g

#19 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Tablet PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (321x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.130 mW/g

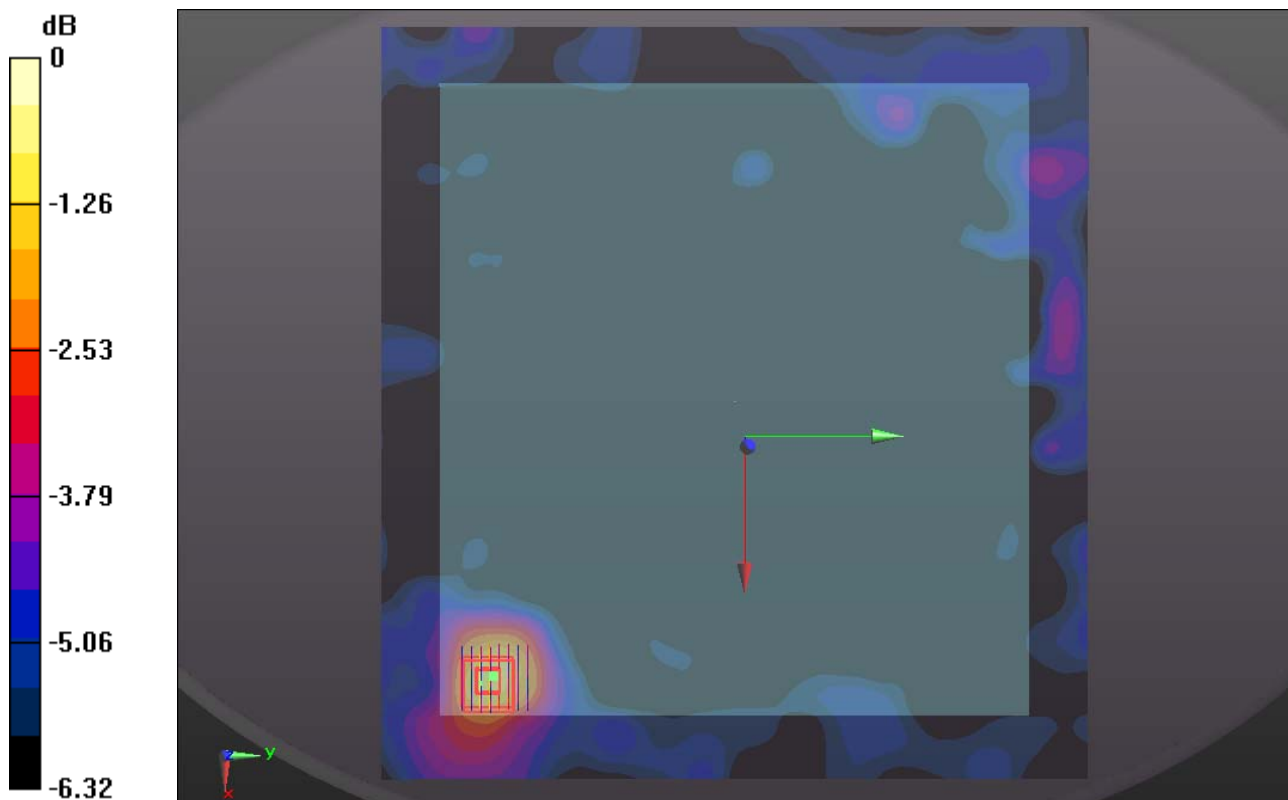
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 2.487 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.251 W/kg

SAR(1 g) = 0.099 mW/g; SAR(10 g) = 0.073 mW/g

Maximum value of SAR (measured) = 0.159 mW/g



0 dB = 0.160mW/g

#20 WLAN 5GHz_802.11n-HT20_Edge 1_0cm_Tablet PC_Ant Degree 0_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (101x321x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.053 mW/g

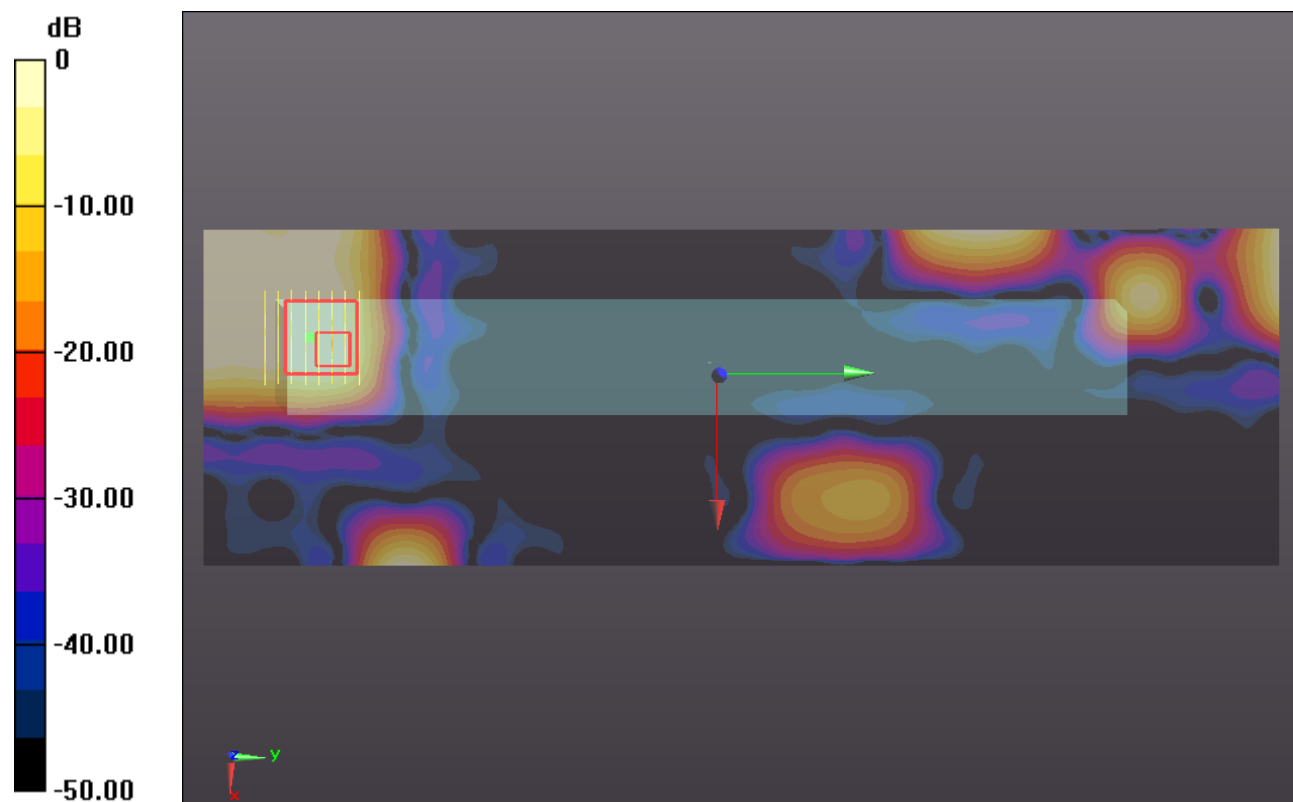
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0.923 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.081 W/kg

SAR(1 g) = 0.0071 mW/g; SAR(10 g) = 0.00239 mW/g

Maximum value of SAR (measured) = 0.026 mW/g



0 dB = 0.030mW/g

#21 WLAN 5GHz_802.11n-HT20_Edge 1_0cm_Tablet PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (101x321x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.070 mW/g

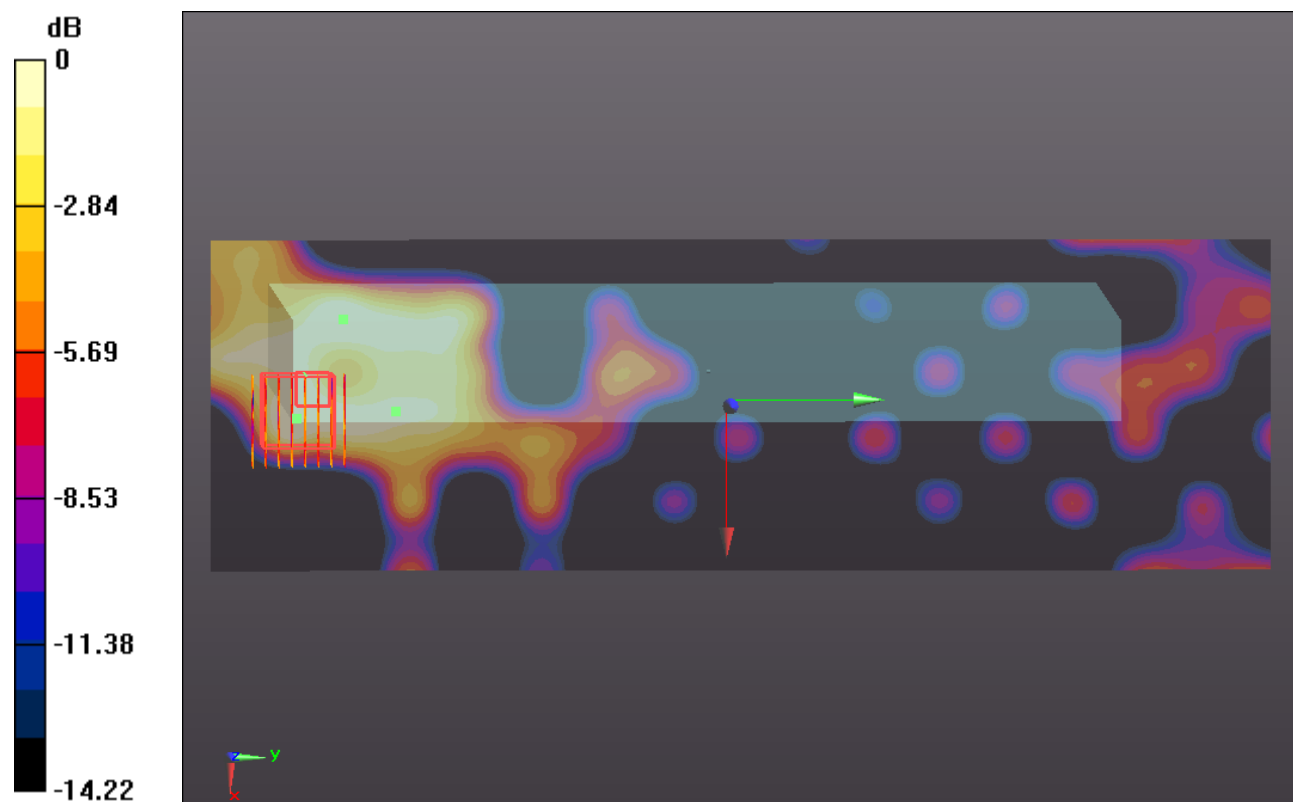
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.065 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.139 W/kg

SAR(1 g) = 0.023 mW/g; SAR(10 g) = 0.016 mW/g

Maximum value of SAR (measured) = 0.053 mW/g



0 dB = 0.050mW/g

#22 WLAN 5GHz_802.11n-HT20_Edge 2_0cm_Tablet PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (121x321x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.011 mW/g

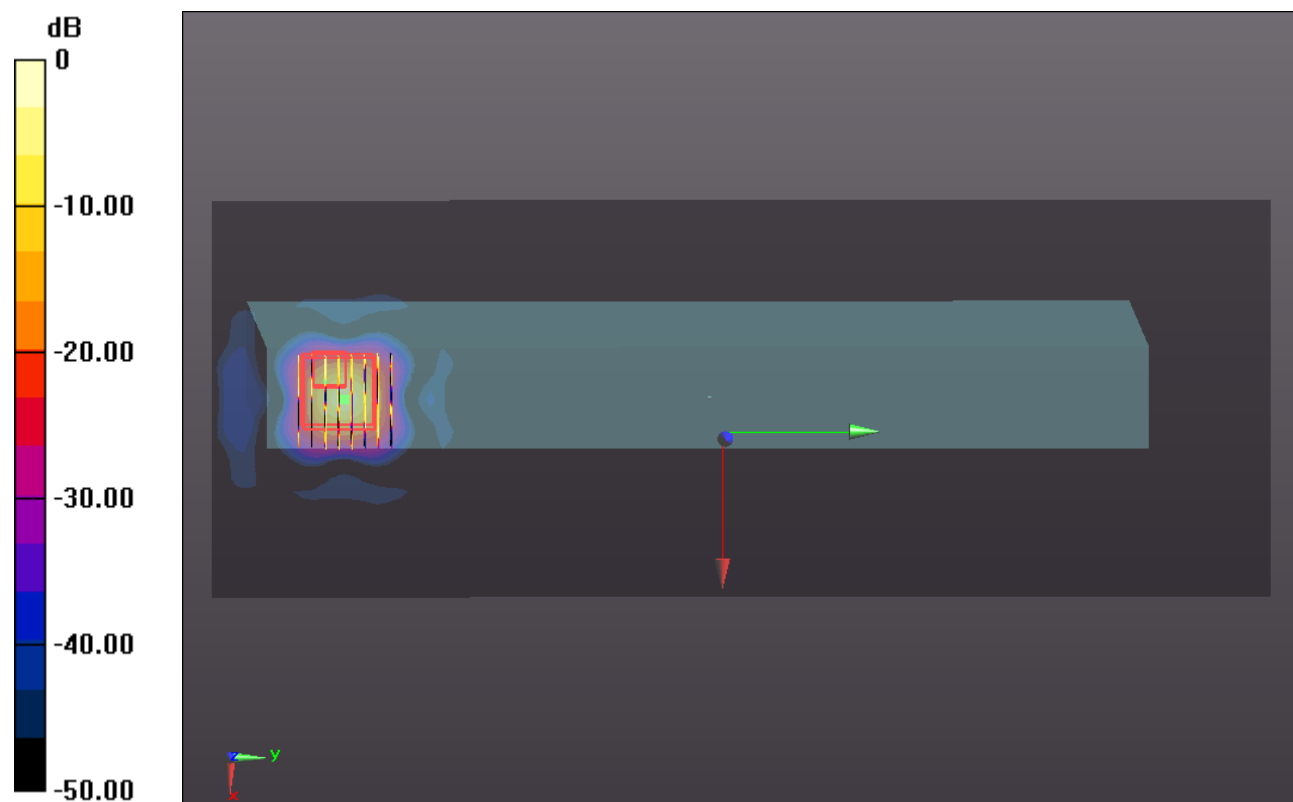
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.127 W/kg

SAR(1 g) = 0.00519 mW/g; SAR(10 g) = 0.000917 mW/g

Maximum value of SAR (measured) = 0.026 mW/g



0 dB = 0.030mW/g

#23 WLAN 5GHz_802.11n-HT20_Edge 3_0cm_Tablet PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (101x321x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.012 mW/g

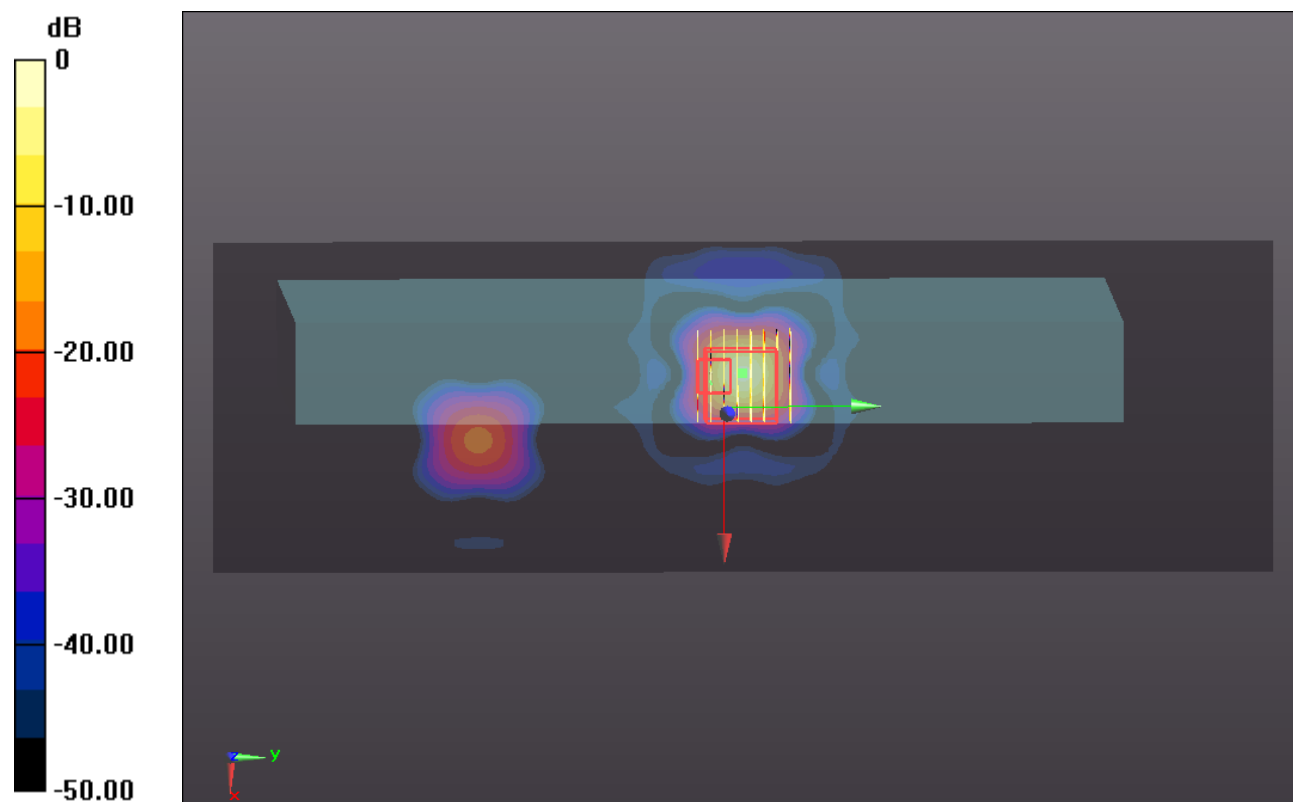
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 0.025 W/kg

SAR(1 g) = 0.00043 mW/g; SAR(10 g) = 0.000102 mW/g

Maximum value of SAR (measured) = 0.021 mW/g



0 dB = 0.020mW/g

#24 WLAN 5GHz_802.11n-HT20_Edge 4_0cm_Tablet PC_Ant Degree 180_44

DUT: 2D1707

Communication System: WIFI; Frequency: 5220 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5220$ MHz; $\sigma = 4.838$ mho/m; $\epsilon_r =$

35.432 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20

- Sensor-Surface: 1.4mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5

- Phantom: SAM3; Type: SAM; Serial: TP-1079

- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch44/Area Scan (81x321x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.148 mW/g

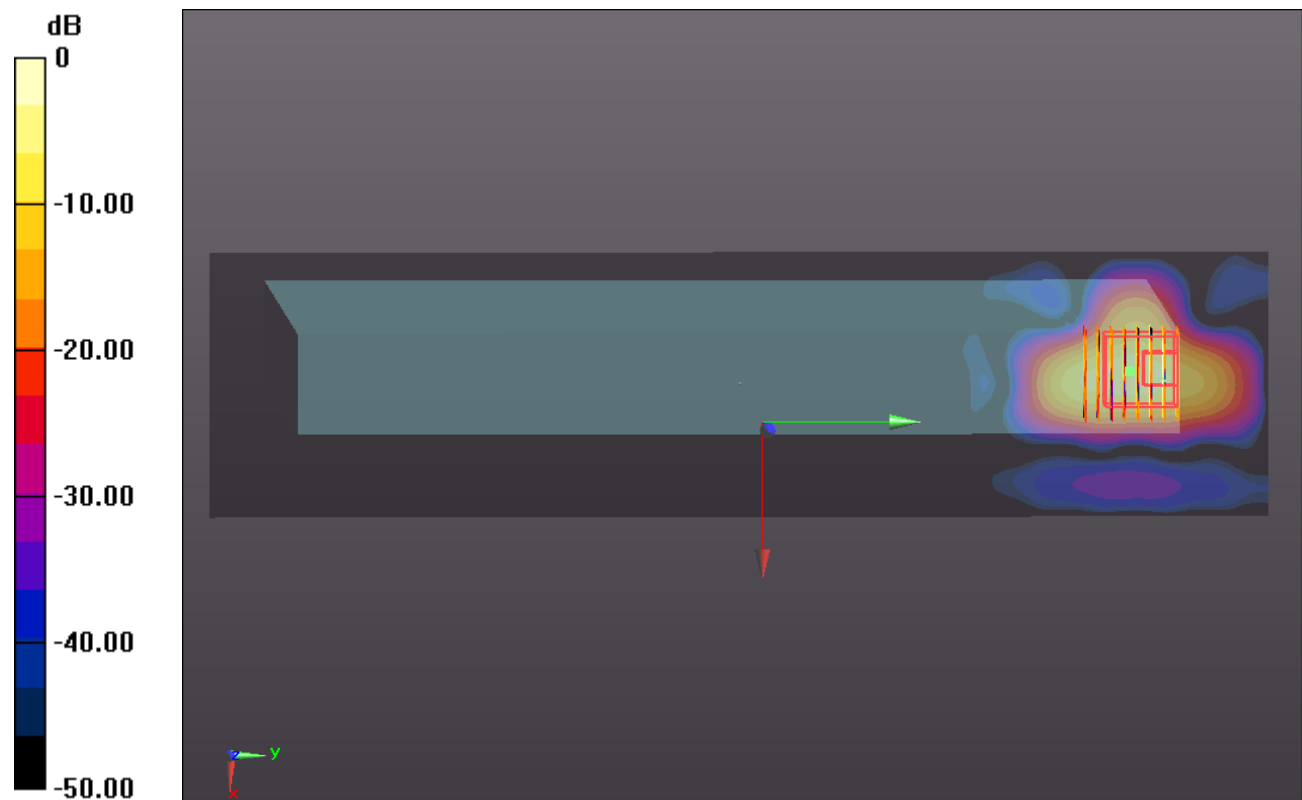
Ch44/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0.461 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 0.598 W/kg

SAR(1 g) = 0.153 mW/g; SAR(10 g) = 0.036 mW/g

Maximum value of SAR (measured) = 0.389 mW/g



0 dB = 0.390mW/g

#25 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Tablet PC_Ant Degree 180_36

DUT: 2D1707

Communication System: WIFI; Frequency: 5180 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5180$ MHz; $\sigma = 4.792$ mho/m; $\epsilon_r =$

35.506 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch36/Area Scan (321x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.131 mW/g

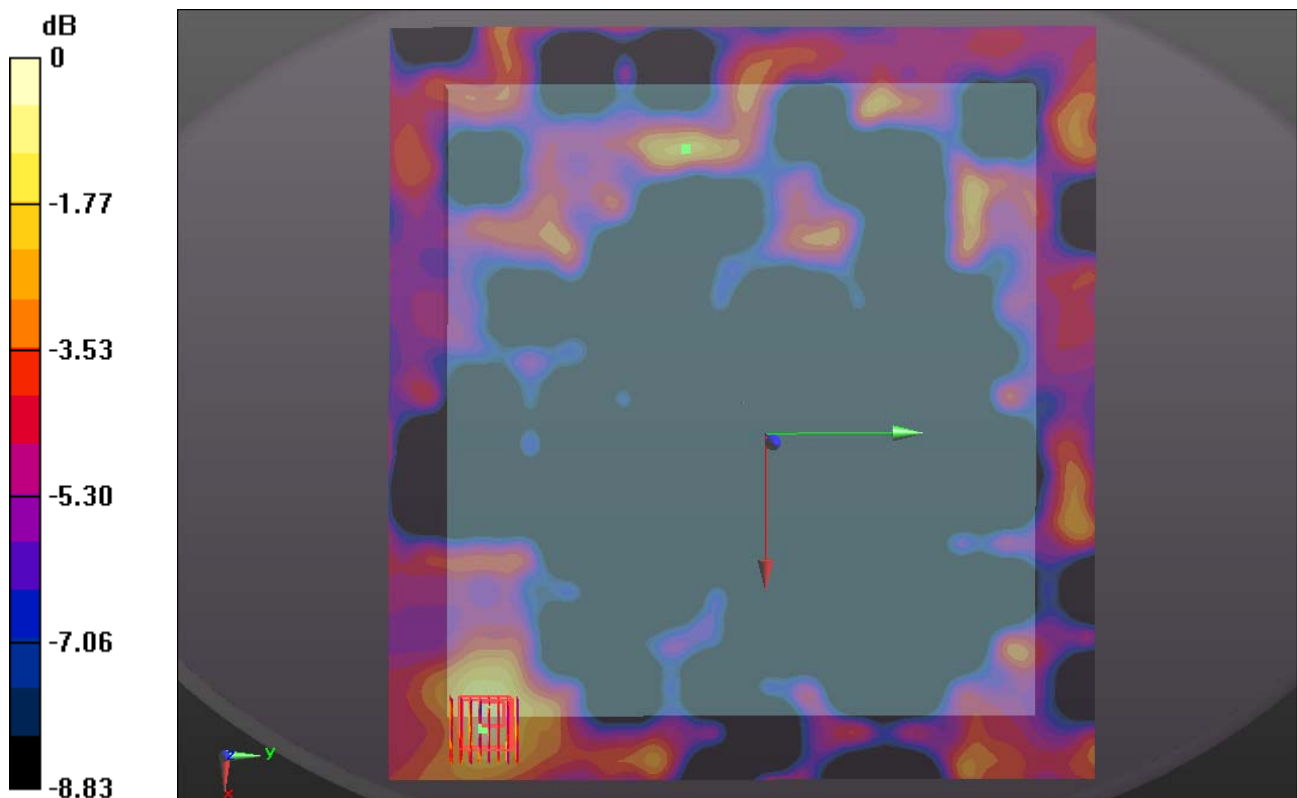
Ch36/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.589 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.204 W/kg

SAR(1 g) = 0.090 mW/g; SAR(10 g) = 0.064 mW/g

Maximum value of SAR (measured) = 0.144 mW/g



0 dB = 0.140mW/g

#26 WLAN 5GHz_802.11n-HT20_Bottom of Laptop_0cm_Tablet PC_Ant Degree 180_48

DUT: 2D1707

Communication System: WIFI; Frequency: 5240 MHz; Duty Cycle: 1:1

Medium: HSL_5000_130214 Medium parameters used: $f = 5240$ MHz; $\sigma = 4.863$ mho/m; $\epsilon_r =$

35.407 ; $\rho = 1000$ kg/m³

Ambient Temperature : 23.2 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3857; ConvF(5.11, 5.11, 5.11); Calibrated: 2012-6-20
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2012-12-5
- Phantom: SAM3; Type: SAM; Serial: TP-1079
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.4.5 (3634)

Ch48/Area Scan (321x301x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.125 mW/g

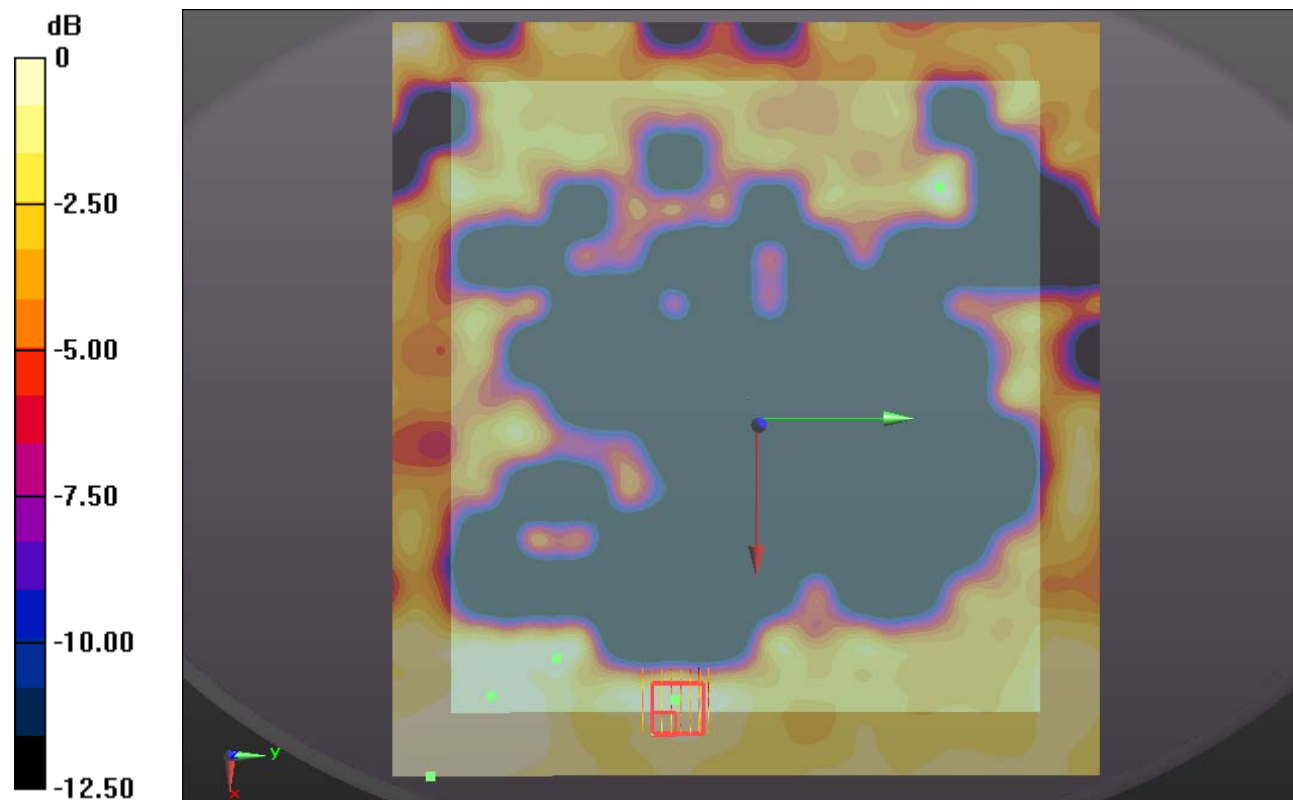
Ch48/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.657 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 0.093 W/kg

SAR(1 g) = 0.050 mW/g; SAR(10 g) = 0.037 mW/g

Maximum value of SAR (measured) = 0.086 mW/g



0 dB = 0.090mW/g



Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'etalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client Sporton (Auden)

Certificate No: D2450V2-736_Jul11

CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 736
Calibration procedure(s): QA CAL-05.v8
Calibration procedure for dipole validation kits above 700 MHz
Calibration date: July 25, 2011

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Table with 4 columns: Equipment Name, ID #, Cal Date (Certificate No.), and Scheduled Calibration. Includes Primary Standards (Power meter, Power sensor, etc.) and Secondary Standards (Power sensor, RF generator, etc.).

Calibrated by: Claudio Leubler, Laboratory Technician
Approved by: Katja Pokovic, Technical Manager

Issued: July 25, 2011

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

**Calibration Laboratory of
Schmid & Partner
Engineering AG**
Zeughausstrasse 43, 8004 Zurich, Switzerland



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:* SAR measured at the stated antenna input power.
- SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.



Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.85 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	54.8 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.44 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.6 mW / g ± 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.7 ± 6 %	2.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	52.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.18 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.5 mW / g ± 16.5 % (k=2)



Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω + 1.5 j Ω
Return Loss	- 27.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.8 Ω + 2.8 j Ω
Return Loss	- 30.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.159 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 26, 2003

DASY5 Validation Report for Head TSL

Date: 25.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 736

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ mho/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

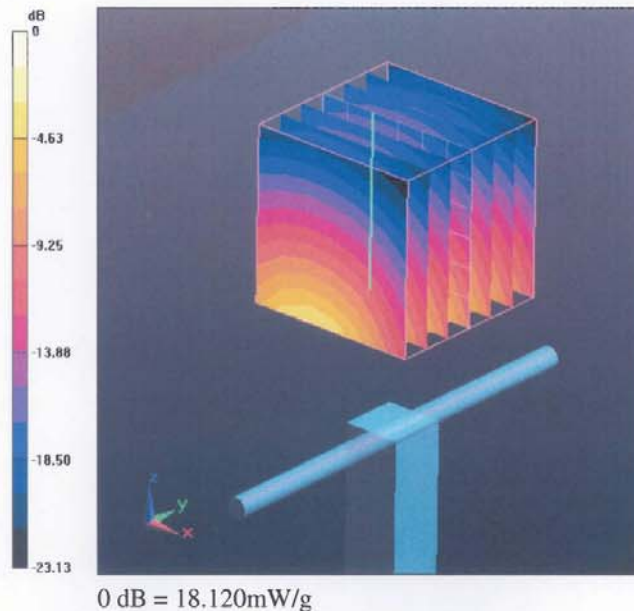
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.095 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.615 W/kg

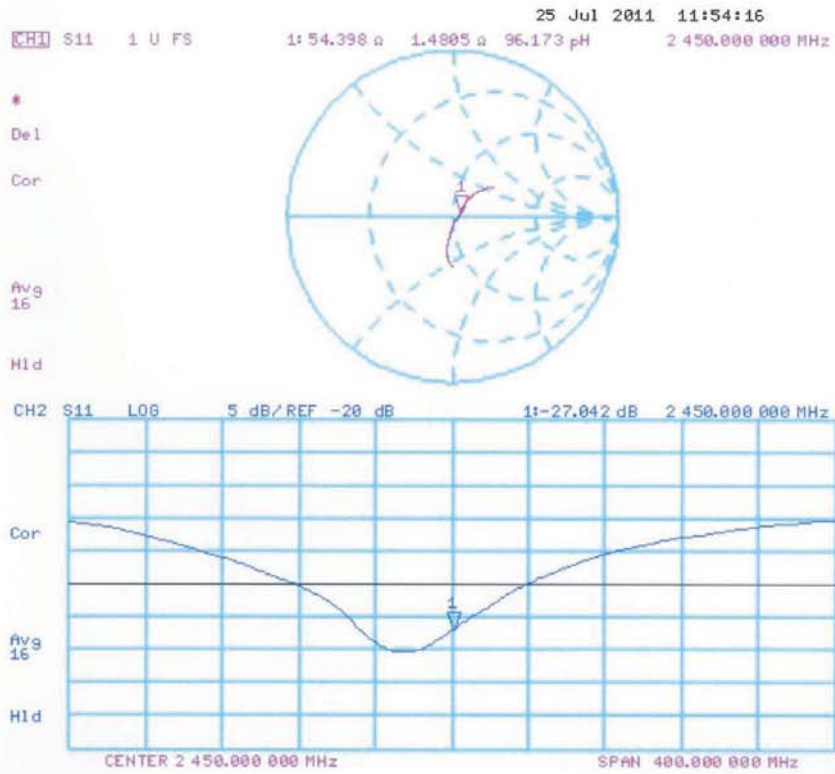
SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.44 mW/g

Maximum value of SAR (measured) = 18.121 mW/g





Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 25.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 736

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ mho/m; $\epsilon_r = 51.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASYS2 52.6.2(482); SEMCAD X 14.4.5(3634)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

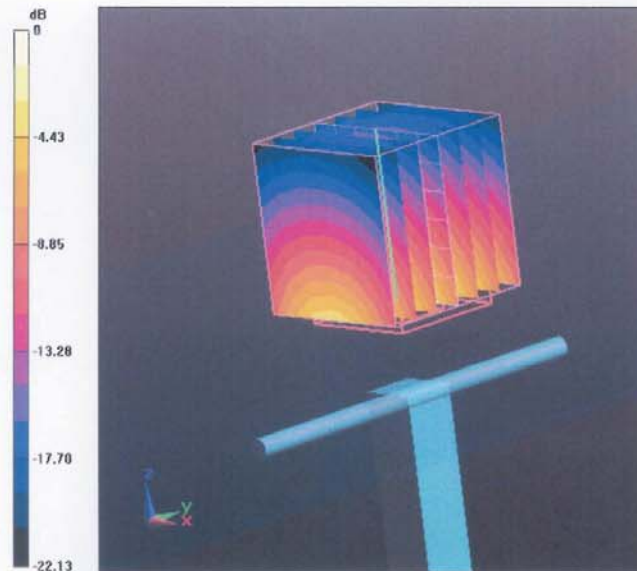
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.550 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 27.432 W/kg

SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.18 mW/g

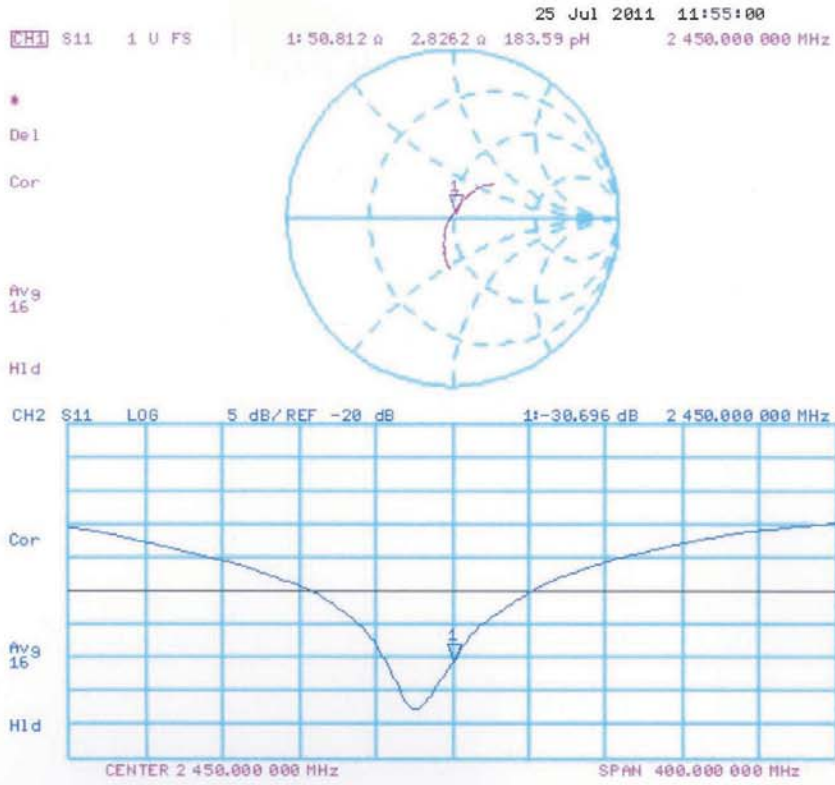
Maximum value of SAR (measured) = 17.294 mW/g



0 dB = 17.290mW/g



Impedance Measurement Plot for Body TSL





D2450V2, serial no. 736 Extended Dipole Calibrations

Referring to KDB 450824, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended.

<Justification of the extended calibration>

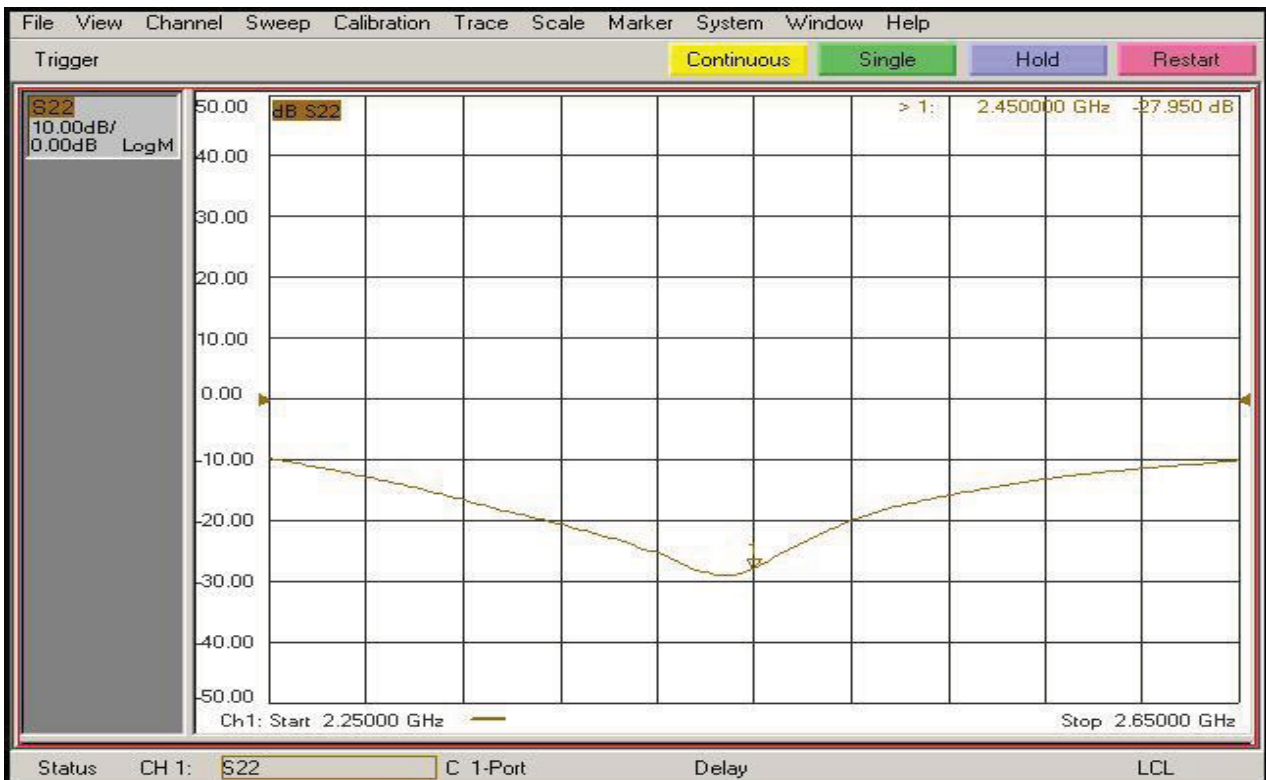
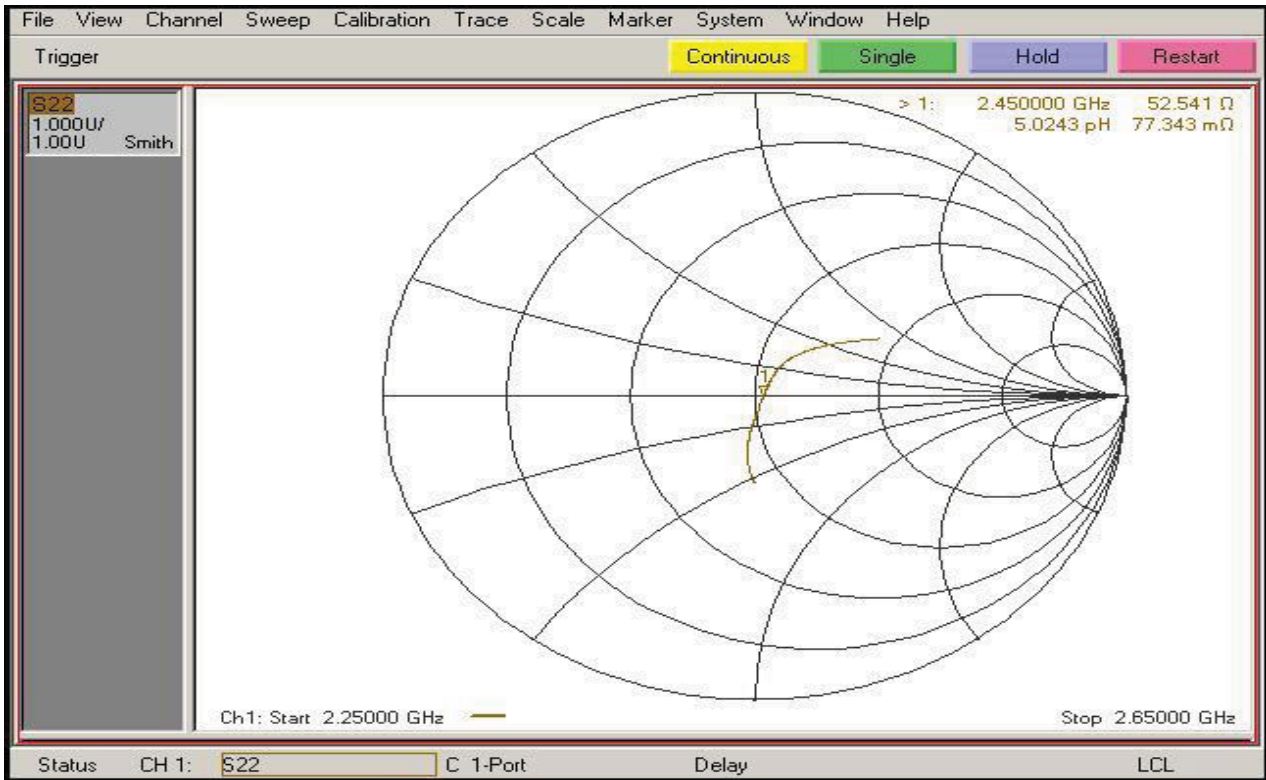
D2450V2 – serial no. 736												
	2450 Head						2450 Body					
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
7.25.2011	-27.042		54.398		1.4805		-30.696		50.812		2.8262	
7.25.2012	-27.950	-3.365	52.541	1.857	0.77343	0.707	-31.781	-3.535	50.572	0.24	1.5953	1.2309

The return loss is < -20dB, within 20% of prior calibration; the impedance is within 5 ohm of prior calibration. Therefore the verification result should support extended calibration.



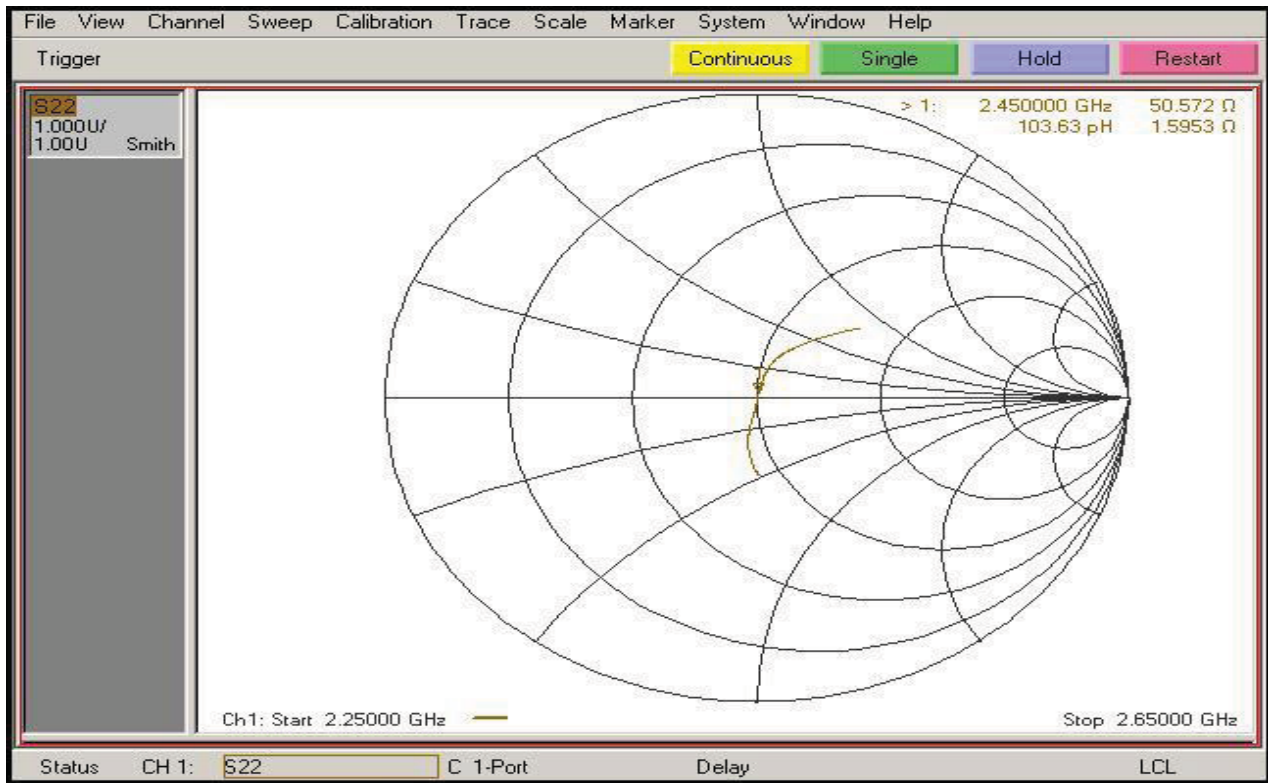
<Dipole Verification Data> - D2450 V2, serial no. 736 (Date of Measurement : 7.25.2012)

2450 MHz - Head





2450 MHz – Body





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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **D5GHzV2-1006_Dec12**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1006**

Calibration procedure(s) **QA CAL-22.v1
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **December 11, 2012**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.3 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe EX3DV4	SN: 3503	30-Dec-11 (No. EX3-3503_Dec11)	Dec-12
DAE4	SN: 601	27-Jun-12 (No. DAE4-601_Jun12)	Jun-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 11, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

- a) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
- b) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- c) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.3
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	4.46 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.05 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	79.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.9	4.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.4 ± 6 %	4.55 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5300 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	82.6 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.6 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.0 ± 6 %	4.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.46 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	83.6 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.8 W/kg ± 19.5 % (k=2)

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	33.8 ± 6 %	5.04 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.27 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.4 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.1 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	71.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.0 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.9 ± 6 %	5.51 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5300 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	73.5 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.5 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.74 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	76.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.3 W/kg ± 19.5 % (k=2)

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.17 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.23 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	71.7 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.00 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	19.8 W/kg ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	$51.8 \Omega - 10.7 j\Omega$
Return Loss	- 19.5 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	$56.1 \Omega - 1.3 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	$56.1 \Omega - 6.6 j\Omega$
Return Loss	- 21.4 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	$56.4 \Omega + 3.9 j\Omega$
Return Loss	- 23.0 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	$51.9 \Omega - 9.6 j\Omega$
Return Loss	- 20.4 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	$56.0 \Omega + 0.1 j\Omega$
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	$56.9 \Omega - 4.5 j\Omega$
Return Loss	- 22.3 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	$57.4 \Omega + 5.9 j\Omega$
Return Loss	- 21.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
----------------------------------	----------

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 11.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1006

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.46$ mho/m; $\epsilon_r = 34.6$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 4.55$ mho/m; $\epsilon_r = 34.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 4.81$ mho/m; $\epsilon_r = 34$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 5.04$ mho/m; $\epsilon_r = 33.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 30.12.2011, ConvF(5.1, 5.1, 5.1); Calibrated: 30.12.2011, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.579 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 8.05 W/kg; SAR(10 g) = 2.31 W/kg

Maximum value of SAR (measured) = 19.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.080 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 31.6 W/kg

SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.39 W/kg

Maximum value of SAR (measured) = 20.2 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

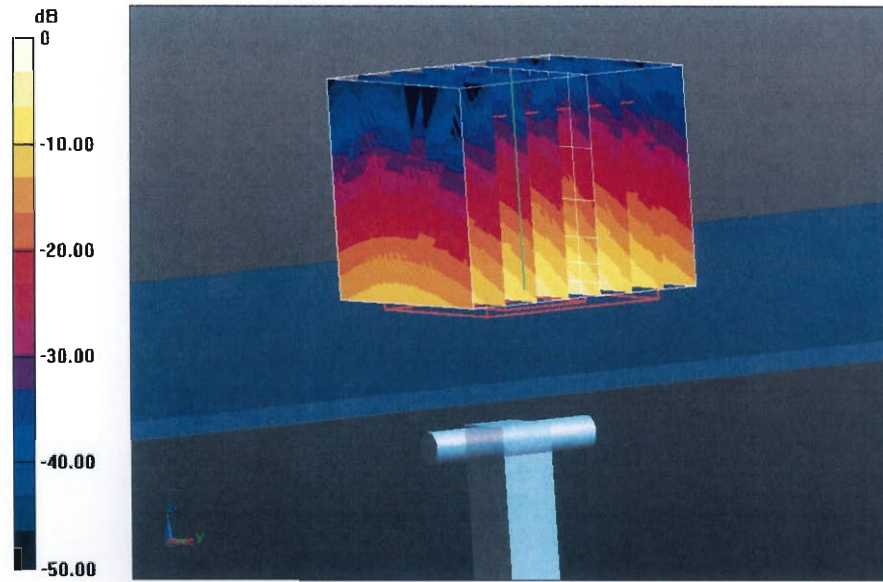
Reference Value = 63.445 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.5 W/kg

SAR(1 g) = 8.46 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 20.9 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.453 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 33.1 W/kg
SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.27 W/kg
Maximum value of SAR (measured) = 20.1 W/kg



0 dB = 20.1 W/kg = 13.03 dBW/kg

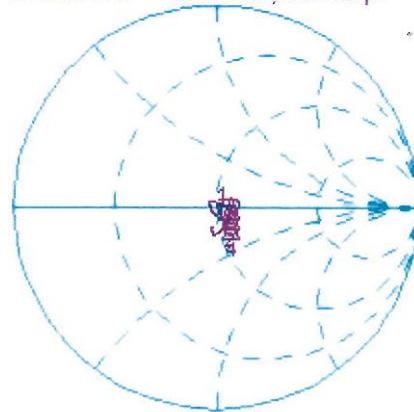
Impedance Measurement Plot for Head TSL

11 Dec 2012 14:32:01

CH1 S11 1 U FS

1: 51.846 Ω -10.689 Ω 2.8633 pF 5 200.000 000 MHz

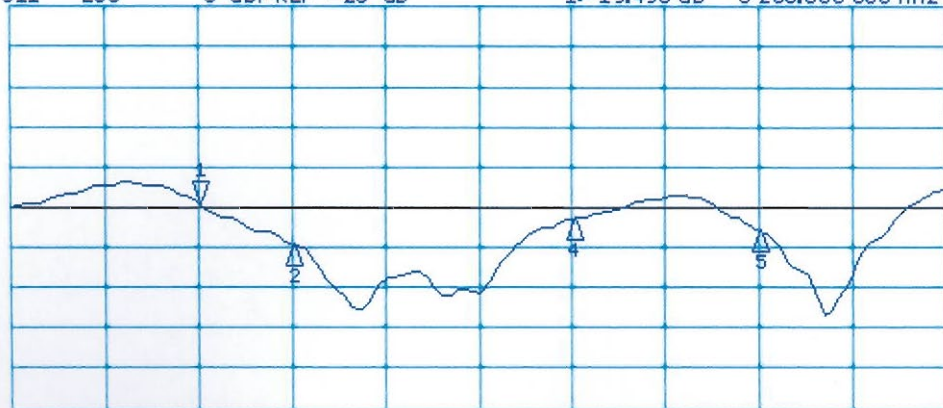
*
De1
Cor
Avg
16
H1d



CH1 Markers
2: 56.100 Ω
-1.2520 Ω
5.30000 GHz
4: 56.107 Ω
-6.6367 Ω
5.60000 GHz
5: 56.414 Ω
3.9121 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -19.498 dB 5 200.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
2: -24.625 dB
5.30000 GHz
4: -21.425 dB
5.60000 GHz
5: -23.030 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 5 800.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 10.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1006

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.4$ mho/m; $\epsilon_r = 47.1$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5300$ MHz; $\sigma = 5.51$ mho/m; $\epsilon_r = 46.9$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5600$ MHz; $\sigma = 5.88$ mho/m; $\epsilon_r = 46.4$; $\rho = 1000$ kg/m³, Medium parameters used: $f = 5800$ MHz; $\sigma = 6.17$ mho/m; $\epsilon_r = 46.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.67, 4.67, 4.67); Calibrated: 30.12.2011, ConvF(4.22, 4.22, 4.22); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 54.463 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 7.2 W/kg; SAR(10 g) = 2.02 W/kg

Maximum value of SAR (measured) = 16.8 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 54.513 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 30.0 W/kg

SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.07 W/kg

Maximum value of SAR (measured) = 17.5 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

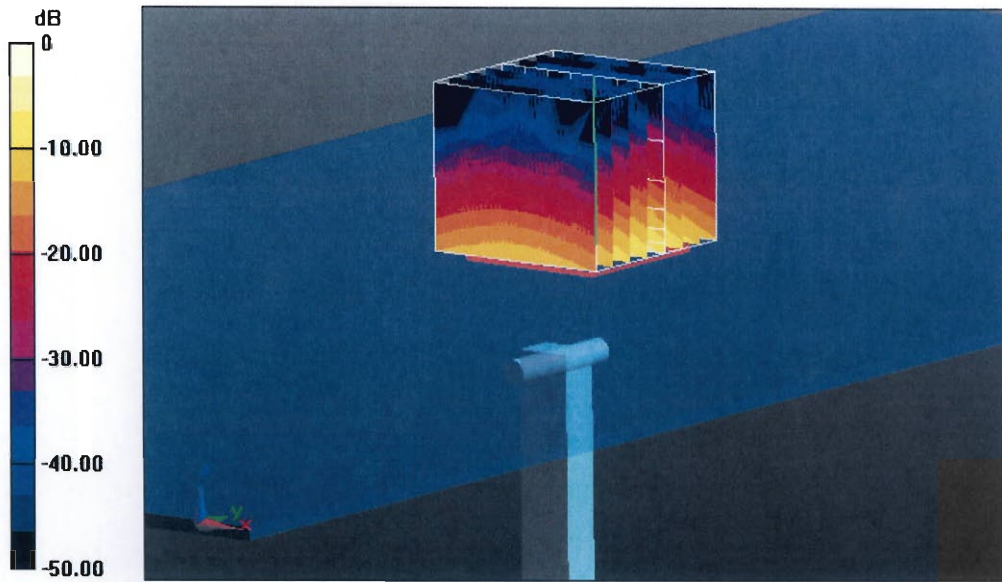
Reference Value = 53.974 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 34.1 W/kg

SAR(1 g) = 7.74 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 19.1 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 50.912 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 33.7 W/kg
SAR(1 g) = 7.23 W/kg; SAR(10 g) = 2 W/kg
Maximum value of SAR (measured) = 18.0 W/kg



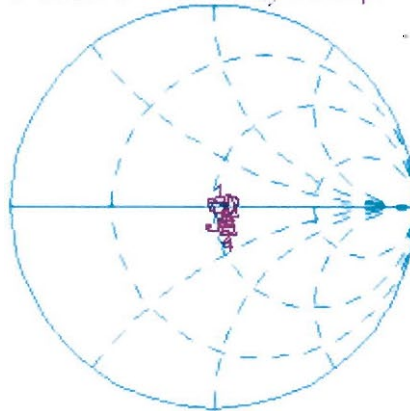
0 dB = 18.0 W/kg = 12.55 dBW/kg

Impedance Measurement Plot for Body TSL

10 Dec 2012 09:48:22

CH1 S11 1 U FS 1: 51.937 Ω -9.5547 Ω 3.2033 pF 5 200.000 000 MHz

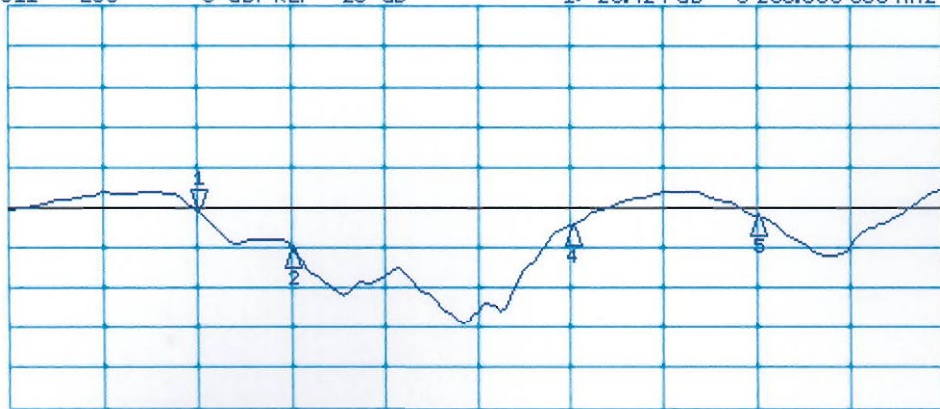
*
De1
Cor
Avg
16
H1d



CH1 Markers
2: 56.039 Ω
0.0762 Ω
5.30000 GHz
4: 56.067 Ω
-4.5195 Ω
5.60000 GHz
5: 57.406 Ω
5.9355 Ω
5.80000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1: -20.424 dB 5 200.000 000 MHz

Cor
Avg
16
H1d



CH2 Markers
2: -24.884 dB
5.30000 GHz
4: -22.282 dB
5.60000 GHz
5: -21.085 dB
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton - CN (Auden)**

Certificate No: **DAE4-1210_Dec12**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 1210**

Calibration procedure(s) **QA CAL-06.v25
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **December 05, 2012**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	

Issued: December 5, 2012

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Accreditation No.: **SCS 108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
 - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
 - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
 - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
 - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
 - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.
 - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
 - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
 - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
 - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 μ V, full range = -100...+300 mV

Low Range: 1LSB = 61nV, full range = -1.....+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.091 \pm 0.1% (k=2)	404.919 \pm 0.1% (k=2)	405.025 \pm 0.1% (k=2)
Low Range	3.99675 \pm 0.7% (k=2)	3.98227 \pm 0.7% (k=2)	3.99772 \pm 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	68 $^{\circ}$ \pm 1 $^{\circ}$
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Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199993.07	-3.75	-0.00
Channel X	+ Input	20003.18	2.60	0.01
Channel X	- Input	-19998.08	2.47	-0.01
Channel Y	+ Input	199994.94	-1.35	-0.00
Channel Y	+ Input	19999.07	-1.63	-0.01
Channel Y	- Input	-20000.95	-0.44	0.00
Channel Z	+ Input	199994.94	-1.97	-0.00
Channel Z	+ Input	19999.33	-1.29	-0.01
Channel Z	- Input	-20000.75	-0.11	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.03	0.11	0.01
Channel X	+ Input	201.53	0.16	0.08
Channel X	- Input	-198.20	0.30	-0.15
Channel Y	+ Input	2000.11	-0.85	-0.04
Channel Y	+ Input	201.00	-0.41	-0.20
Channel Y	- Input	-199.21	-0.67	0.34
Channel Z	+ Input	2000.86	0.03	0.00
Channel Z	+ Input	200.73	-0.40	-0.20
Channel Z	- Input	-199.67	-0.94	0.47

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-4.74	-6.48
	- 200	8.83	7.16
Channel Y	200	-9.74	-9.75
	- 200	5.98	5.81
Channel Z	200	11.87	12.25
	- 200	-14.43	-13.83

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	1.37	-3.24
Channel Y	200	8.19	-	3.26
Channel Z	200	9.26	5.75	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15949	17607
Channel Y	15961	16469
Channel Z	15876	17309

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	1.08	0.33	2.52	0.41
Channel Y	-0.94	-2.10	-0.06	0.40
Channel Z	-0.82	-1.73	0.09	0.39

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9



Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **EX3-3857_Jun12**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3857**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **June 20, 2012**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature

Issued: June 20, 2012

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Accreditation No.: **SCS 108**

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,y,z}**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3857

Manufactured: January 23, 2012
Calibrated: June 20, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.18	0.44	0.46	$\pm 10.1 \%$
DCP (mV) ^B	97.3	100.5	98.0	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
0	CW	0.00	X	0.00	0.00	1.00	152.9	$\pm 4.1 \%$
			Y	0.00	0.00	1.00	199.2	
			Z	0.00	0.00	1.00	147.7	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	9.25	9.25	9.25	0.14	1.52	± 12.0 %
835	41.5	0.90	8.74	8.74	8.74	0.10	2.56	± 12.0 %
900	41.5	0.97	8.75	8.75	8.75	0.10	2.73	± 12.0 %
1750	40.1	1.37	8.14	8.14	8.14	0.60	0.71	± 12.0 %
1900	40.0	1.40	7.84	7.84	7.84	0.54	0.78	± 12.0 %
2450	39.2	1.80	6.87	6.87	6.87	0.34	1.08	± 12.0 %
5200	36.0	4.66	5.11	5.11	5.11	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.91	4.91	4.91	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.74	4.74	4.74	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.49	4.49	4.49	0.45	1.80	± 13.1 %
5800	35.3	5.27	4.69	4.69	4.69	0.45	1.80	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

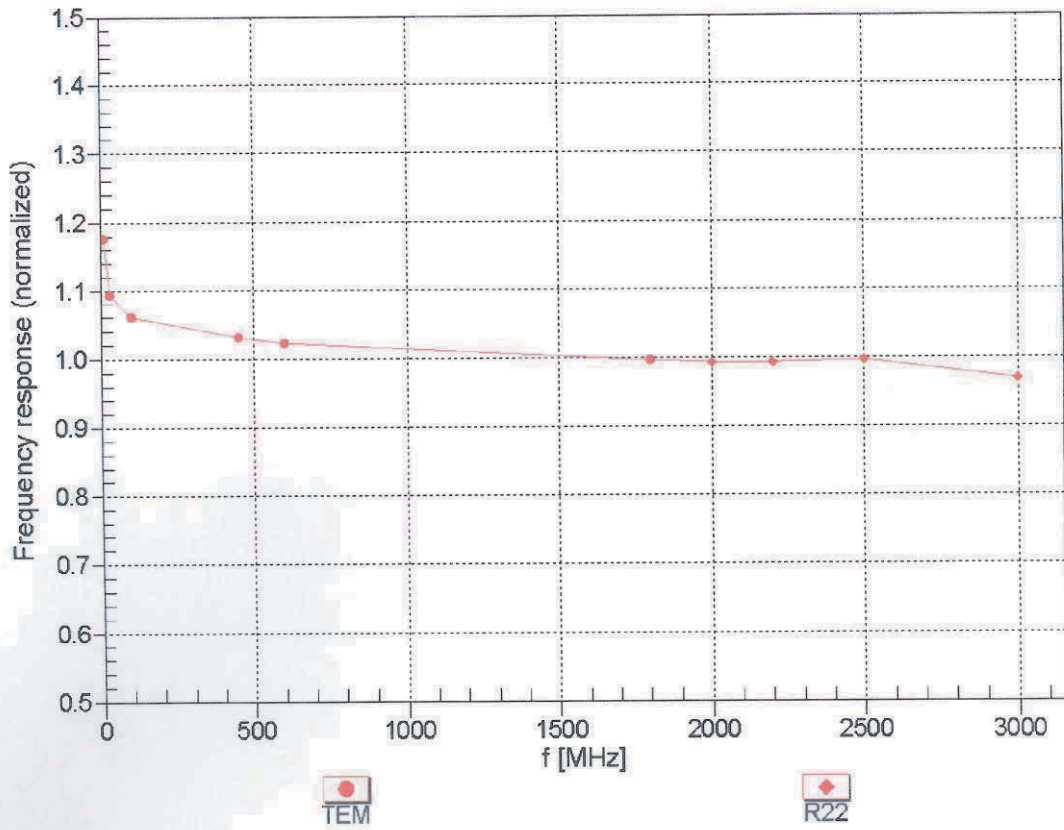
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	9.18	9.18	9.18	0.15	1.79	± 12.0 %
835	55.2	0.97	8.98	8.98	8.98	0.14	1.88	± 12.0 %
900	55.0	1.05	8.94	8.94	8.94	0.24	1.20	± 12.0 %
1750	53.4	1.49	7.68	7.68	7.68	0.23	1.25	± 12.0 %
1900	53.3	1.52	7.35	7.35	7.35	0.12	2.37	± 12.0 %
2450	52.7	1.95	6.94	6.94	6.94	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.30	4.30	4.30	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.15	4.15	4.15	0.45	1.90	± 13.1 %
5500	48.6	5.65	3.91	3.91	3.91	0.52	1.90	± 13.1 %
5600	48.5	5.77	4.06	4.06	4.06	0.42	1.90	± 13.1 %
5800	48.2	6.00	3.99	3.99	3.99	0.55	1.90	± 13.1 %

^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F At frequencies below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

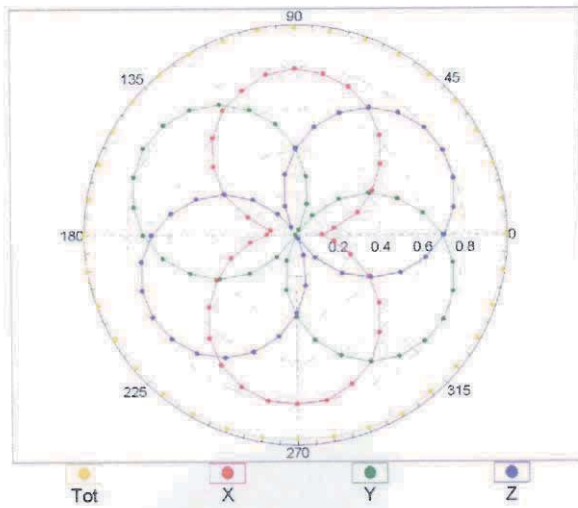
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



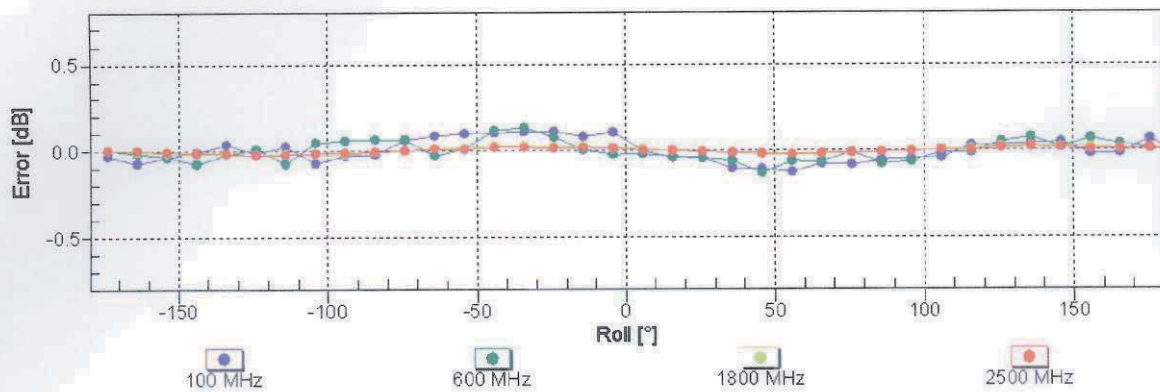
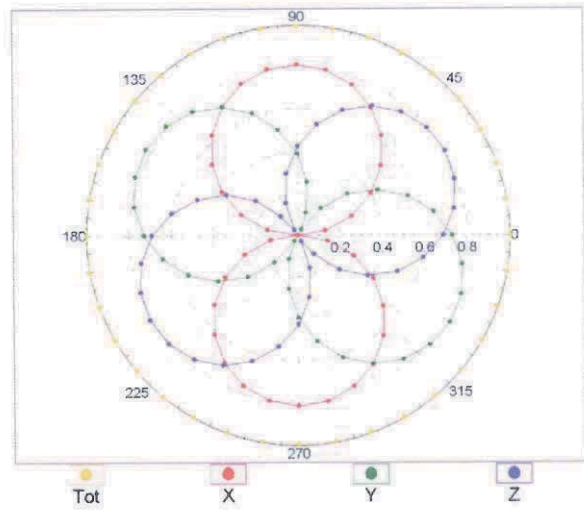
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz, TEM

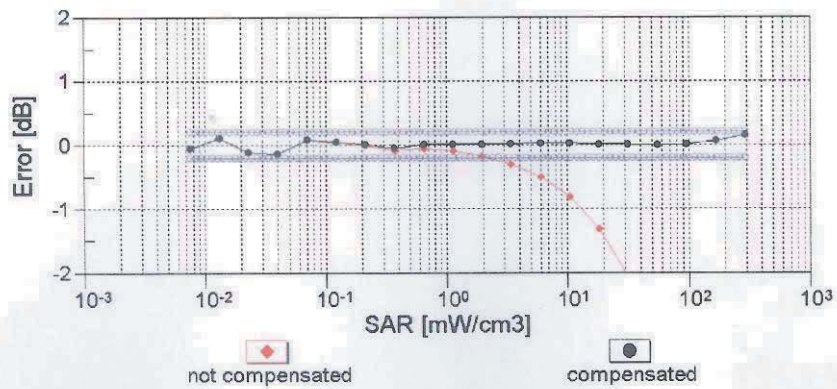
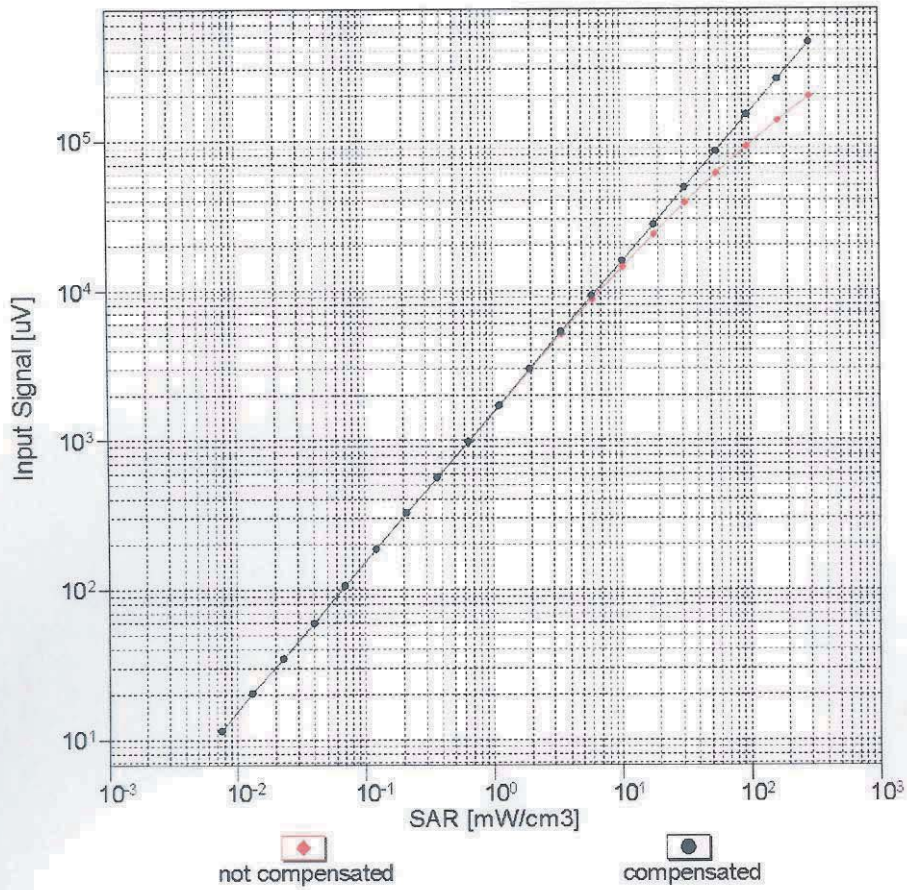


f=1800 MHz, R22



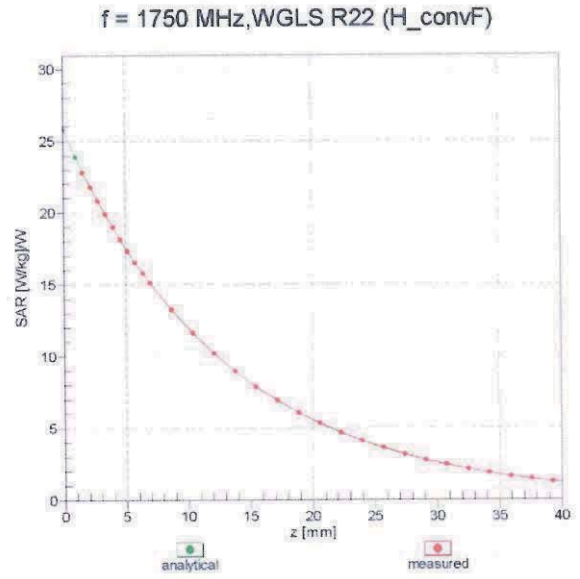
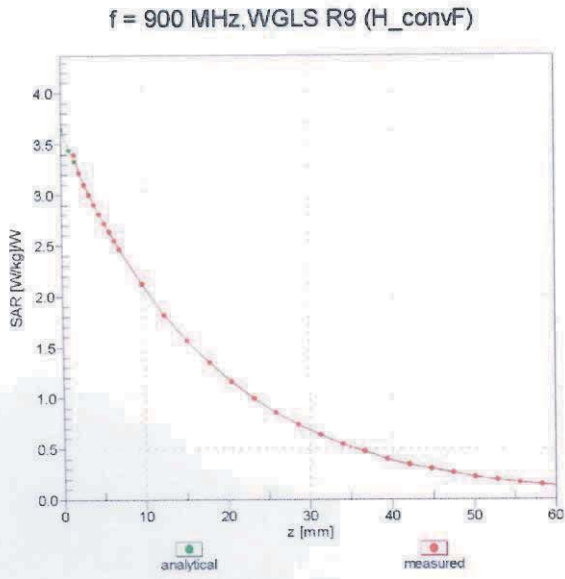
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range f(SAR_{head}) (TEM cell , f = 900 MHz)

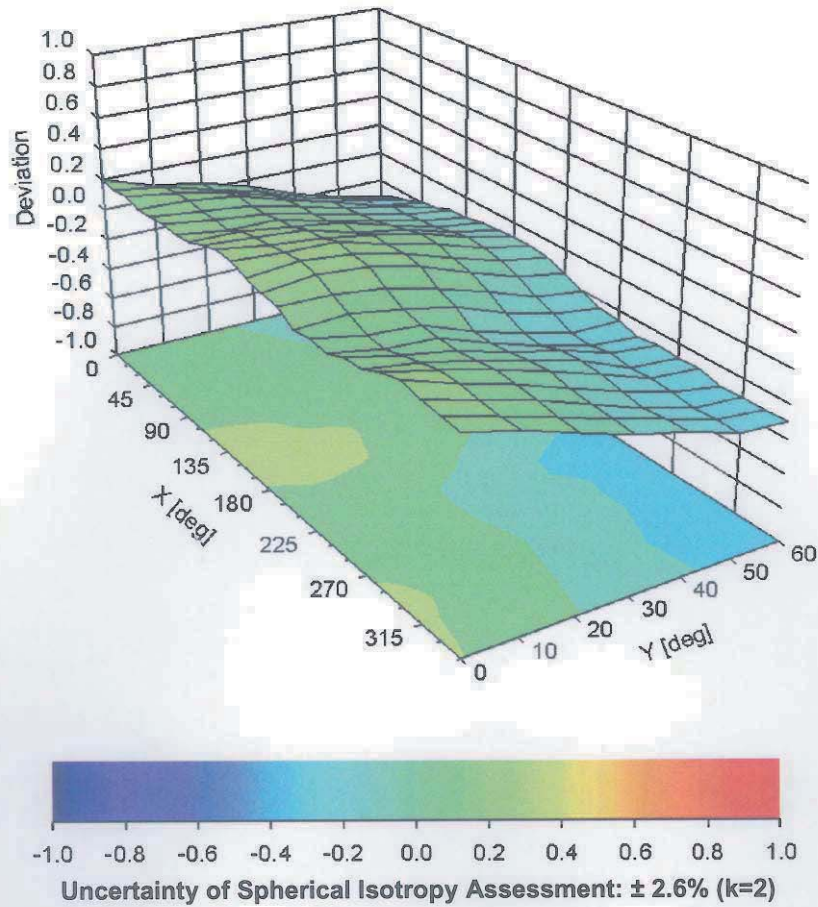


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3857

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	135.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm